

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



**Curriculum
for
Fourth Year of Computer Engineering
(2019 Course)
(With effect from 2022-23)**

Savitribai Phule Pune University
Third Year of Computer Engineering (2019 Course)
(With effect from Academic Year 2021-22)

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Savitribai Phule Pune University
Bachelor of Computer Engineering
Program Outcomes (POs)

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.

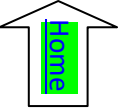
Program Specific Outcomes (PSO)

PSO1	Professional Skills- The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, multimedia, web design, big data analytics, and networking for efficient design of computer-based systems of varying complexities.
PSO2	Problem-Solving Skills- The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver a quality product for business success.
PSO3	Successful Career and Entrepreneurship- The ability to employ modern computer languages, environments, and platforms in creating innovative career paths to be an entrepreneur, and a zest for higher studies.

BE Computer Engineering 2019 Course tentative Curriculum structure:

Savitribai Phule Pune University Final Year of Computer Engineering (2019 Course) (With effect from Academic Year 2022-23)														
Semester VII														
Course Code	Course Name	Teaching Scheme (Hours/week)			Examination Scheme and Marks						Credit Scheme			
		Lecture	Practical	Tutorial	Mid-Sem	End-Sem	Term work	Practical	Oral\Pre	Total	Lecture	Practical	Tutorial	Total
410241	Design and Analysis of Algorithms	03	-	-	30	70	-	-	-	100	3	-	-	3
410242	Machine Learning	03	-	-	30	70	-	-	-	100	3	-	-	3
410243	Blockchain Technology	03	-	-	30	70	-	-	-	100	3	-	-	3
410244	Elective III	03	-	-	30	70	-	-	-	100	3	-	-	3
410245	Elective IV	03	-	-	30	70	-	-	-	100	3	-	-	3
410246	Laboratory Practice III	-	04	-	-	-	50	50	-	100	-	2	-	2
410247	Laboratory Practice IV	-	02	-	-	-	50	-	-	50	-	1	-	1
410248	Project Stage I	-	02	-	-	-	50	-	-	50	-	2	-	2
Total Credit											15	05	-	20
Total		15	08	-	150	350	150	50	-	700	15	05	-	20
410249	Audit Course 7										Grade			
Elective III						Elective IV								
410244(A) Pervasive Computing 410244(B) Multimedia Techniques 410244(C) Cyber Security and Digital Forensics 410244(D) Object Oriented Modeling and Design 410244(E) Digital Signal Processing						410245(A) Information Retrieval 410245(B) GPU Programming and Architecture 410245(C) Mobile Computing 410245(D)Software Testing and Quality Assurance 410245(E) Compilers								
Laboratory Practice III: Laboratory assignments Courses- 410241, 410242, 410243						Laboratory Practice IV: Laboratory assignments Courses- 410244, 410245								
Audit Course 7(AC7) Options: AC7- I MOOC- Learn New Skills AC7- II Entrepreneurship Development AC7- III Botnet of Things AC7- IV 3D Printing AC7- V Industrial Safety and Environment Consciousness														

SEMESTER VII



Savitribai Phule Pune University

Fourth Year of Computer Engineering (2019 Course)

410241: Design and Analysis of Algorithms

Teaching Scheme: TH: 03 Hours/Week	Credit 03	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks
Prerequisites Courses: Discrete Mathematics (210241), Fundamentals of Data Structures(210242, Data Structures and Algorithms(210252), Theory of Computation (310242)		
Companion Course: Laboratory Practice III(410246)		
Course Objectives: • To develop problem solving abilities using mathematical theories. • To apply algorithmic strategies while solving problems. • To analyze performance of different algorithmic strategies in terms of time and space. • To develop time and space efficient algorithms. • To study algorithmic examples in distributed and concurrent environments • To Understand Multithreaded and Distributed Algorithms		
Course Outcomes: On completion of the course, student will be able to– CO1: Formulate the problem CO2: Analyze the asymptotic performance of algorithms CO3: Decide and apply algorithmic strategies to solve given problem CO4: Find optimal solution by applying various methods CO5: Analyze and Apply Scheduling and Sorting Algorithms. CO6: Solve problems for multi-core or distributed or concurrent environments		
Course Contents		
Unit I	Algorithms and Problem Solving	07 Hours
Algorithm: The Role of Algorithms in Computing - What are algorithms, Algorithms as technology, Evolution of Algorithms, Design of Algorithm, Need of Correctness of Algorithm, Confirming correctness of Algorithm – sample examples, Iterative algorithm design issues. Problem solving Principles: Classification of problem, problem solving strategies, classification of time complexities (linear, logarithmic etc.)		
#Exemplar/Case Studies	Towers of Hanoi	
*Mapping of Course Outcomes for Unit I	CO1,CO3	
Unit II	Analysis of Algorithms and Complexity Theory	07 Hours
Analysis: Input size, best case, worst case, average case Counting Dominant operators, Growth rate, upper bounds, asymptotic growth, O , Ω , Θ , o and ω notations, polynomial and non-polynomial problems, deterministic and non-deterministic algorithms, P- class problems, NP-class of problems, Polynomial problem reduction NP complete problems- vertex cover and 3-SAT and NP hard problem - Hamiltonian cycle.		
#Exemplar/Case Studies	Analysis of iterative and recursive algorithm	

*Mapping of Course Outcomes for Unit II	CO2
Unit III	Greedy And Dynamic Programming algorithmic Strategies 08 Hours
Greedy strategy: Principle, control abstraction, time analysis of control abstraction, knapsack problem, scheduling algorithms-Job scheduling and activity selection problem. Dynamic Programming: Principle, control abstraction, time analysis of control abstraction, binomial coefficients, OBST, 0/1 knapsack, Chain Matrix multiplication.	
#Exemplar/Case Studies	Rail tracks connecting all the cities
*Mapping of Course Outcomes for Unit III	CO3, CO4
Unit IV	Backtracking and Branch-n-Bound 08 Hours
Backtracking: Principle, control abstraction, time analysis of control abstraction, 8-queen problem, graph coloring problem, sum of subsets problem. Branch-n-Bound: Principle, control abstraction, time analysis of control abstraction, strategies- FIFO, LIFO and LC approaches, TSP, knapsack problem.	
#Exemplar/Case Studies	Airline Crew Scheduling
*Mapping of Course Outcomes for Unit IV	CO3, CO4
Unit V	Amortized Analysis 07 Hours
Amortized Analysis: Aggregate Analysis, Accounting Method, Potential Function method, Amortized analysis-binary counter, stack Time-Space tradeoff, Introduction to Tractable and Non-tractable Problems, Introduction to Randomized and Approximate algorithms, Embedded Algorithms: Embedded system scheduling (power optimized scheduling algorithm), sorting algorithm for embedded systems.	
#Exemplar/Case Studies	cutting stock problem
*Mapping of Course Outcomes for Unit V	CO3, CO5
Unit VI	Multithreaded And Distributed Algorithms 07 Hours
Multithreaded Algorithms - Introduction, Performance measures, Analyzing multithreaded algorithms, Parallel loops, Race conditions. Problem Solving using Multithreaded Algorithms - Multithreaded matrix multiplication, Multithreaded merge sort. Distributed Algorithms - Introduction, Distributed breadth first search, Distributed Minimum Spanning Tree. String Matching- Introduction, The Naive string matching algorithm, The Rabin-Karp algorithm.	
#Exemplar/Case Studies	Plagiarism detection

***Mapping of Course Outcomes for UnitVI**

CO6

**Learning Resources****Text Books:**

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

Reference Books :

1. Michael T. Goodrich, Roberto Tamassia, “Algorithm Design: Foundations,” Analysis and Internet Examples, Wiley, ISBN 978-81-265-0986-7
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, “Introduction to Algorithms”, MIT Press; ISBN 978-0-262-03384-8
3. Horowitz and Sahani, "Fundamentals of Computer Algorithms", University Press, ISBN: 978 817371 6126, 81 7371 61262
4. Rajeev Motwani and Prabhakar Raghavan, “Randomized Algorithms” Cambridge University Press, ISBN: 978-0-521-61390-3
5. Dan Gusfield, “Algorithms on Strings, Trees and Sequences”, Cambridge University Press, ISBN: 0-521-67035-7

e-Books :

1. https://www.tutorialspoint.com/design_and_analysis_of_algorithms/design_and_analysis_of_algorithms_tutorial.pdf
2. <https://www.ebooks.com/en-in/book/1679384/algorithms-design-techniques-and-analysis/m-h-alsuwaiyel>

MOOC Courses links :

- Design and Analysis of Algorithms - <https://nptel.ac.in/courses/106106131>

@The CO-PO Mapping Matrix

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



Savitribai Phule Pune University Fourth Year of Computer Engineering (2019 Course) 410242: Machine Learning		
Teaching Scheme: TH: 03 Hours/Week	Credit 03	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks
Prerequisite Courses: Data Science and Big Data Analytics(310251)		
Companion Course: Laboratory Practice III(410246)		
Course Objectives: - To understand the need for Machine learning - To explore various data pre-processing methods. - To study and understand classification methods - To understand the need for multi-class classifiers. - To learn the working of clustering algorithms - To learn fundamental neural network algorithms.		
Course Outcomes: On completion of the course, student will be able to– CO1: Identify the needs and challenges of machine learning for real time applications. CO2: Apply various data pre-processing techniques to simplify and speed up machine learning algorithms. CO3: Select and apply appropriately supervised machine learning algorithms for real timeapplications. CO4: Implement variants of multi-class classifier and measure its performance. CO5 :Compare and contrast different clustering algorithms. CO6: Design a neural network for solving engineering problems.		
Course Contents		
Unit I	Introduction To Machine Learning	07 Hours
Introduction to Machine Learning, Comparison of Machine learning with traditional programming, ML vs AI vs Data Science. Types of learning: Supervised, Unsupervised, and semi-supervised, reinforcement learning techniques, Models of Machine learning: Geometric model, Probabilistic Models, Logical Models, Grouping and grading models, Parametric and non-parametric models. Important Elements of Machine Learning- Data formats, Learnability, Statistical learning approaches		
#Exemplar/Case Studies	Suppose you are working for Uber where a task to increase sales is given. Understand the requirements of the client	
*Mapping of Course Outcomes for Unit	CO1	
Unit II	Feature Engineering	07 Hours

Concept of Feature, Preprocessing of data: Normalization and Scaling, Standardization, Managing missing values, Introduction to Dimensionality Reduction, Principal Component Analysis (PCA), Feature Extraction: Kernel PCA, Local Binary Pattern.

Introduction to various Feature Selection Techniques, Sequential Forward Selection, Sequential Backward Selection.

Statistical feature engineering: count-based, Length, Mean, Median, Mode etc. based feature vector creation.

Multidimensional Scaling, Matrix Factorization Techniques.

#Exemplar/Case Studies

You are a Data Scientist, and a client comes to you with their data. Client is running a few campaigns from the past few months, but no campaign seem effective. Client provides you the data of customers, product sales and past campaign success.

They want to increase their sales and figure out which marketing strategy is working the best for them?

Questions for data scientists:

1. What data analysis approach will you follow?

2. What statistical approach do you need to follow?

How will you select important features?

*Mapping of Course Outcomes for Unit II

CO2

Unit III Supervised Learning : Regression 06 Hours

Bias, Variance, Generalization, Underfitting, Overfitting, Linear regression, Regression: Lasso regression, Ridge regression, Gradient descent algorithm.

Evaluation Metrics: MAE, RMSE, R2

#Exemplar/Case Studies

Stock market price prediction

*Mapping of Course Outcomes for Unit III

CO3

Unit IV Supervised Learning : Classification 08 Hours

Classification: K-nearest neighbour, Support vector machine.

Ensemble Learning: Bagging, Boosting, Random Forest, Adaboost.

Binary-vs-Multiclass Classification, Balanced and Imbalanced Multiclass Classification

Problems, Variants of Multiclass Classification: One-vs-One and One-vs-All

Evaluation Metrics and Score: Accuracy, Precision, Recall, Fscore, Cross-validation, Micro-Average Precision and Recall, Micro-Average F-score, Macro-Average Precision and Recall, Macro-Average F-score.

#Exemplar/Case Studies

Prediction of Thyroid disorders such as Hyperthyroid, Hypothyroid, Euthyroid-sick, and Euthyroid using multiclass classifier.

*Mapping of Course Outcomes for Unit IV

CO4

Unit V Unsupervised Learning 07 Hours

K-Means, K-medoids, Hierarchical, and Density-based Clustering, Spectral Clustering. Outlier analysis: introduction of isolation factor, local outlier factor.

Evaluation metrics and score: elbow method, extrinsic and intrinsic methods

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#Exemplar/Case Studies	Market basket analysis/Customer Segmentation		
*Mapping of Course Outcomes for Unit V	CO5		
Unit VI	Introduction To Neural Networks		07 Hours
Artificial Neural Networks: Single Layer Neural Network, Multilayer Perceptron, Back Propagation Learning, Functional Link Artificial Neural Network, and Radial Basis Function Network, Activation functions, Introduction to Recurrent Neural Networks and Convolutional Neural Networks			
#Exemplar/Case Studies	Movie Recommendation System		
*Mapping of Course Outcomes for Unit VI	CO6		
Learning Resources			
Text Books:			
1. Bishop, Christopher M., and Nasser M. Nasrabadi, "Pattern recognition and machine learning", Vol. 4.No. 4. New York: springer, 2006. 2. Ethem Alpaydin, "Introduction to Machine Learning", PHI 2nd Edition-2013			
Reference Books:			
1. Tom Mitchell, "Machine learning", McGraw-Hill series in Computer Science, 1997 2. Shalev-Shwartz, Shai, and Shai Ben-David, "Understanding machine learning: From theory to algorithms", Cambridge university press, 2014. 3. Jiawei Han, Micheline Kamber, and Jian Pie, "Data Mining: Concepts and Techniques", Elsevier Publishers Third Edition, ISBN: 9780123814791, 9780123814807 4. Hastie, Trevor, et al., "The elements of statistical learning: data mining, inference, and prediction", Vol. 2. New York: springer, 2009. 5. McKinney, "Python for Data Analysis", O'Reilly media, ISBN : 978-1-449-31979-3 6. Trent hauk, "Scikit-learn", Cookbook, Packt Publishing, ISBN: 9781787286382 7. Goodfellow I.,Bengio Y. and Courville, "A Deep Learning", MIT Press, 2016			
e-Books :			
1. Python Machine Learning : http://www.ru.ac.bd/wp-content/uploads/sites/25/2019/03/207_05_01_Rajchka_Using-Python-for-machine-learning-2015.pdf 2. Foundation of Machine Learning: https://cs.nyu.edu/~mohri/mlbook/ 3. Dive into Deep Learning: http://d2l.ai/ 4. A brief introduction to machine learning for Engineers: https://arxiv.org/pdf/1709.02840.pdf 5. Feature selection: https://dl.acm.org/doi/pdf/10.5555/944919.944968 6. Introductory Machine Learning Nodes : http://lcs.mit.edu/courses/ml/1718/MLNotes.pdf			
MOOC Courses Links:			
• Introduction to Machine Learning : https://nptel.ac.in/courses/106105152 • Introduction to Machine Learning (IIT Madras): https://onlinecourses.nptel.ac.in/noc22_cs29/preview • Deep learning: https://nptel.ac.in/courses/106106184			

@The CO-PO Mapping Matrix

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



Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course)
410243: Blockchain Technology

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

Prerequisite Courses: Computer Networks and Security(310244)

Companion Course: Laboratory Practice III(410246)

Course Objectives:

- Technology behind Blockchain
- Crypto currency, Bitcoin and Smart contracts
- Different consensus algorithms used in Blockchain
- Real-world applications of Blockchain
- To analyze Blockchain Ethereum Platform using Solidity
- To Describe Blockchain Case Studies

Course Outcomes:

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

CO1: Interpret the fundamentals and basic concepts in Blockchain

CO2: Compare the working of different blockchain platforms

CO3: Use Crypto wallet for cryptocurrency based transactions

CO4: Analyze the importance of blockchain in finding the solution to the real-world problems.

CO5: Illustrate the Ethereum public block chain platform

CO6: Identify relative application where block chain technology can be effectively used and implemented.

Course Contents

Unit I	Mathematical Foundation for Blockchain	06 Hours
Cryptography: Symmetric Key Cryptography and Asymmetric Key Cryptography, Elliptic Curve Cryptography (ECC), Cryptographic Hash Functions: SHA256, Digital Signature Algorithm (DSA), Merkel Trees.		
#Exemplar/Case Studies	Compare the Symmetric and Asymmetric Cryptography algorithms	
*Mapping of Course Outcomes for Unit I	CO1	
Unit II	Feature Engineering	07 Hours
History, Centralized Vs. Decentralized Systems, Layers of Blockchain: Application Layer, Execution Layer, Semantic Layer, Propagation Layer, Consensus Layer, Why is Block chain important? Limitations of Centralized Systems, Blockchain Adoption So Far.		

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<u>#Exemplar/Case Studies</u>	Study of a research paper based on Blockchain.	
<u>*Mapping of Course Outcomes for Unit II</u>	CO1	
Unit III	Blockchain Platforms and Consensus in Blockchain	06 Hours
Types of Blockchain Platforms: Public, Private and Consortium, Bitcoin, Ethereum, Hyperledger, IoT, Corda, R3. Consensus in Blockchain: Consensus Approach, Consensus Elements, Consensus Algorithms, Proof of Work, Byzantine General problem, Proof of Stake, Proof of Elapsed Time, Proof of Activity, Proof of Burn.		
<u>#Exemplar/Case Studies</u>	Compare different consensus algorithms used in Blockchain Technology.	
<u>*Mapping of Course Outcomes for Unit III</u>	CO2	
Unit IV	Cryptocurrency – Bitcoin, and Token	06 Hours
Introduction, Bitcoin and the Cryptocurrency, Cryptocurrency Basics Types of Cryptocurrency, Cryptocurrency Usage, Cryptowallets: Metamask, Coinbase, Binance		
<u>#Exemplar/Case Studies</u>	Create your own wallet for crypto currency using any of the Blockchain Platforms.	
<u>*Mapping of Course Outcomes for Unit IV</u>	CO3	
Unit V	Blockchain Ethereum Platform using Solidity	06 Hours
What is Ethereum, Types of Ethereum Networks, EVM (Ethereum Virtual Machine), Introduction to smart contracts, Purpose and types of Smart Contracts, Implementing and deploying smart contracts using Solidity, Swarm (Decentralized Storage Platform), Whisper (Decentralized Messaging Platform)		
<u>#Exemplar/Case Studies</u>	Study Truffle Development Environment.	
<u>*Mapping of Course Outcomes for Unit V</u>	CO4	
Unit VI	Blockchain Case Studies	06 Hours
Prominent Blockchain Applications, Retail, Banking and Financial Services, Government Sector, Healthcare, IOT, Energy and Utilities, Blockchain Integration with other Domains		
<u>#Exemplar/Case Studies</u>	Study 2 uses cases of Blockchain and write a detailed report on every aspect implemented in the same	
<u>*Mapping of Course Outcomes for Unit VI</u>	CO5, CO6	
Learning Resources		

Text Books:

1. Martin Quest, "Blockchain Dynamics: A Quick Beginner's Guide on Understanding the Foundations of Bit coin and Other Crypto currencies", Create Space Independent PublishingPlatform, 15-May-2018
2. Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained", Second Edition, Packt Publishing, 2018
3. Alex Leverington, "Ethereum Programming", Packt Publishing, 2017

Reference Books:

1. Bikramaditya Singhal, Gautam Dhameja, Priyansu Sekhar Panda, "Beginning Blockchain A Beginner's Guide to Building Blockchain Solutions", 2018
2. Chris Dannen, "Introducing Ethereum and Solidity", Foundations of Crypto currency and Blockchain Programming for Beginners
3. Daniel Drescher, "Blockchain Basics", A Non -Technical Introduction in 25Steps.
4. Ritesh Modi, "Solidity Programming Essentials", Packt Publishing, 2018
5. Chandramouli Subramanian, Asha A George, Abhilash K A and Meena Karthikeyan, "Blockchain Technology", Universities Press, ISBN-9789389211634

e-Books :

1. https://users.cs.fiu.edu/~prabakar/cen5079/Common/textbooks/Mastering_Blockchain_2nd_Edition.pdf
2. https://www.lopp.net/pdf/princeton_bitcoin_book.pdf
3. <https://www.blockchainexpert.uk/book/blockchain-book.pdf>

MOOC Courses Links:

1. NPTEL Course on "Introduction to Blockchain Technology & Applications"
<https://nptel.ac.in/courses/106/104/106104220/>
2. NPTEL Course on b
<https://nptel.ac.in/courses/106/105/106105184/>

@The CO-PO Mapping Matrix

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



Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course)
410244(A): Pervasive Computing

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

Prerequisite Courses: -Internet of Things and Embedded Systems(310245A)

Companion Course: Laboratory Practice IV(410247)

Course Objectives:

- To introduce the characteristics, basic concepts and systems issues in pervasive computing.
- To illustrate smart devices and architectures in pervasive computing.
- To introduce intelligent systems and interactions in Pervasive computing.
- To identify the trends and latest development of the technologies in the area.
- To Understand Interaction Design – HCI and Wearable Computing Environment.
- To identify Security Challenges & Ethics in Pervasive Computing

Course Outcomes:

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

- CO1.Demonstrate fundamental concepts in pervasive computing.
- CO2.Explain pervasive devices and decide appropriate one as per the need of real time applications.
- CO3.Classify and analyze context aware systems for their efficiency in different ICT systems.
- CO4.Illustrate intelligent systems and generic intelligent interactive applications.
- CO5.Design HCI systems in pervasive computing environment.
- CO6.Explore the security challenges and know the role of ethics in the context of pervasive computing.

Course Contents

Unit I	Introduction To Pervasive Computing	07 Hours
Pervasive Computing: History, Principles, Characteristics, Problems/Issues & Challenges, Advantages of Pervasive Computing Pervasive Computing Applications: Pervasive computing devices and interfaces, Device technology trends, Connecting issues and protocols.		
#Exemplar/Case Studies	Pervasive Computing for Personalized medicine	
*Mapping of Course Outcomes for Unit I	CO1	
Unit II	Smart Computing with Pervasive Computing Devices	07 Hours
Smart Devices: CCI, Smart Environment: CPI and CCI, Smart Devices: iHCI and HPI, Wearable devices, Application and Requirements, Device Technology and Connectivity, PDA Device characteristics - PDA Based Access Architecture, Voice Enabling Pervasive Computing: Voice Standards, Speech Applications in Pervasive Computing.		
#Exemplar/CaseStudies	Amazon Alexa	

*Mapping of Course Outcomes for Unit II		CO2
Unit III	Context Aware Systems	07 Hours
Introduction, Types of Context, Context Aware Computing and Applications, Modelling Context-Aware Systems, Mobility awareness, spatial awareness, temporal awareness: Coordinating and scheduling, ICT system awareness, Middleware Support		
#Exemplar/Case Studies	Mobile Hanging Services systems	
*Mapping of Course Outcomes for Unit III	CO3	
Unit IV	Intelligent Systems and Interaction	07 Hours
Introduction, Basic Concepts, IS Architectures, Semantic KBIS, Classical Logic IS, Soft Computing IS Models, IS System Operations, Interaction Multiplicity, IS Interaction Design, Generic Intelligent Interaction Applications.		
#Exemplar/Case Studies	Curious information displays: A motivated reinforcement learning IE application.	
*Mapping of Course Outcomes for Unit IV	CO4	
Unit V	User Interaction Design – HCI and Wearable Computing	07 Hours
Introduction of Interaction Design, Basics of Interaction Design and its Concepts, Importance of Interaction Design, Difference between Interaction Design and UX. What is HCI? Importance of HCI, Advantages and Disadvantages of HCI, Elements of HCI, HCI Design and Architecture, Define Wearable Computing, Importance of Wearable Computing, Security issues in Wearable Computing, Wearable Computing Architecture and Applications, Wearable Computing Challenges and Opportunities for Privacy Protection		
#Exemplar/Case Studies	Smart Fabric/ Textile, Sensory Fabric for Ubiquitous interfaces	
*Mapping of Course Outcomes for Unit V	CO5	
Unit VI	Security Challenges & Ethics in Pervasive Computing	07 Hours
Security issues in Pervasive Computing: security model, authentication & authorization, access control, secure resource discovery, open issues. Pervasive computing security challenges & requirements: Privacy & trust issues, social & user interaction issues, solution for pervasive computing challenges, Role of Ethics in pervasive computing security: Autonomy and Self-determination, Responsibility: legal, moral & social, distributive justice, digital divide and sustainable development		
#Exemplar/Case Studies	Pervasive Computing Security Gaia Project	
*Mapping of Course Outcomes for Unit VI	CO6	
Learning Resources		

Text Books:

1. Stefan Poslad, "Ubiquitous Computing: Smart Devices: Environments and Interactions", Wiley Publication, Student Edition, ISBN 9788126527335.
2. Jochen Burkhardt, Horst Henn, Stefan Hepper, Klaus Rindtroff, Thomas Schack, "Pervasive Computing: Technology and Architecture of Mobile Internet Applications", Pearson Education, ISBN 9788177582802
3. Frank Adelstein, Sandeep K. S. Gupta, Golden G. Richard III, Loren Schwiebert, "Fundamentals of Mobile and Pervasive Computing" McGraw Hill Education, Indian Edition, ISBN 9780070603646

Reference Books:

1. Sen Loke, "Context Aware Pervasive Systems; Architectures for new Breed of applications", Taylor and Fransis, ISBN 0-8493-7255-0
2. LaurnceYang, Evi Syukur, Seng Loke, "Handbook on Mobile and Ubiquitous Computing : Status and Perspectivel", CRC Press, 2013 ISBN 978-1-4398-4811-1
3. M. Haque and S. I. Ahamed, "Security in pervasive computing: Current status and open issues", Int. J. Netw. Secur., vol. 3, no. 3, pp. 203–214, 2006.

e-Books :

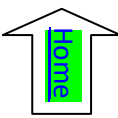
1. M. Hilty, -Ubiquitous Computing in the Workplace: What Ethical Issues? no. August, pp. 1–16, 2014, [Online]. <http://link.springer.com/bookseries/11156L>.
2. <https://web.uettaxila.edu.pk/CMS/SP2014/teMPCms/tutorial%5CFundamentalsOfMobilePervasiveComputing.pdf>
3. http://pervasivecomputing.se/M7012E_2014/material/Wiley.Ubiquitous.Computing.Smart.Devices.Environments.And.Interactions.May.2009.eBook.pdf
4. http://media.techtarget.com/searchMobileComputing/downloads/Mobile_and_pervasive_computing_Ch06.pdf

MOOC Courses Links:

<https://www.georgiancollege.ca/academics/part-time-studies/courses/mobile-and-pervasive-computing-comp-3025/>

@The CO-PO Mapping Matrix

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



Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course)
410244(B): Multimedia Techniques

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

Prerequisite Courses: Computer Graphics (210241)

Companion Course: Laboratory Practice IV(410247)

Course Objectives:

- To understand input and output devices, device drivers, control signals and protocols, DSPs
- To study and use standards (e.g., audio, graphics, video)
- To implement applications, media editors, authoring systems, and authoring by studying streams/structures, capture/represent/transform, spaces/domains, compression/coding
- To design and develop content-based analysis, indexing, and retrieval of audio, images, animation, and video
- To demonstrate presentation, rendering, synchronization, multi-modal integration/interfaces
- To Understand IoT architecture's and Multimedia Internet of things

Course Outcomes:

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

CO1: Describe the media and supporting devices commonly associated with multimedia information and systems.

CO2: Demonstrate the use of content-based information analysis in a multimedia information system.

CO3: Critique multimedia presentations in terms of their appropriate use of audio, video, graphics, color, and other information presentation concepts.

CO4: Implement a multimedia application using an authoring system.

CO5: Understanding of technologies for tracking, navigation and gestural control.

CO6: Implement Multimedia Internet of Things Architectures.

Course Contents

Unit I	Introduction to multimedia	07 Hours
What is Multimedia and their Components, History of Multimedia; Hypermedia, WWW, and Internet; Multimedia Tools: Static (text, graphics, and still images), Active (sound, animation, and video, etc.); Multimedia Sharing and Distribution; Multimedia Authoring Tools: Adobe Premiere, Adobe Director, Adobe Flash.		
#Exemplar/Case Studies	To study and install open-source multimedia Tools	
*Mapping of Course Outcomes for Unit I	CO1	
Unit II	Graphics and Data Representation Techniques	07 Hours
What are Graphics data types, 1-bit Images, 8 –bit grey level ,16-bit grey level images, Image data type, Image data type: 8 bit & 24-bit color images, Higher bit depth images, Color Lookup tables. File Formats: GIF, JPEG, PNG, TIFF, PSD, APS, AI, INDD, RAW, Windows BMP, Windows WMF,		

Netpbm format, EXIF, PTM, Text file format: RTF, TGA Applications/Use of text in Multimedia

#Exemplar/CaseStudies

To study conversion of image file formats from one to Other.

***Mapping of Course**

CO2

Outcomes for Unit II

Unit III	Multimedia Representations Techniques	07 Hours
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Principal concepts for the analog video: CRT, NTSC Video (National Television System Committee), PAL Video (Phase Alternating Line), SECAM Video (System Electronic Couleur Avec Memoire), Digital Video: Chroma Subsampling, High-Definition TV, Ultra High Definition TV (UHDTV), Component Video: High-Definition Multimedia Interface (HDMI), 3D Video and TV: various cues, Basics of Digital Audio: What is Sound?, Nyquist Theorem, SNR, SQNR, Audio Filtering, Synthetic Sounds, MIDI Overview: Hardware, Structure, Conversion to WAV, Coding of Audio: PCM, DPCM, DM (Delta Modulation)

#Exemplar/Case Studies

Install and use Handbrake (link is <https://handbrake.fr>) software to understand the concept of interlaced, deinterlace, noise filters, bitrate, and frame rate for any sample 30 min video, and note down the observations from the output video.

***Mapping of Course Outcomes for Unit III**

CO3

Unit IV	Compression Algorithms	07 Hours
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Introduction to multimedia – Graphics, Image and Video representations – Fundamental concepts of video, digital audio – Storage requirements of multimedia applications – Need for compression – Types of compression algorithms- lossless compression algorithms RLC, VLC, DBC, AC, lossless image compression, differential coding of Images, lossy compression algorithms-Rate distortion theory, Quantization, Transform coding, wavelet based coding, embedded Zerotress of wavelet coefficients. Image compression standard -JPEG standard, JPEG 2000 standard, LS standard, Bilevel image compression standard. Introduction to video compression - video compression based on motion compensation, Search for motion vectors, MPEG Video coding I, MPEG 1,2,4,7 onwards. Basic Audio Compression Techniques -ADPCM in speech coding, Vocoders, MPEG audio compression

#Exemplar/Case Studies

Implementation of compression algorithms

***Mapping of Course Outcomes for Unit IV**

CO3, CO4

Unit V	Augmented Reality(AR), Virtual Reality (VR) and Mixed Reality (MR)	07 Hours
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Basics of Virtual Reality, difference between Virtual Reality and Augmented Reality, Requirement of Augmented Reality, Components and Performance issues in AR, Design and Technological foundations for Immersive Experiences. Input devices – controllers, motion trackers and motion capture technologies for tracking, navigation and gestural control. Output devices – Head Mounted VR Displays, Augmented and Mixed reality glasses. 3D interactive and procedural graphics. Immersive surround sound. Haptic and vibrotactile devices. Best practices in VR, AR and MR Future applications of Immersive Technologies.

VRML Programming Modeling objects and virtual environments Domain Dependent applications: Medical, Visualization, Entertainment, etc.

#Exemplar/Case Studies

Navigation Assistance System

***Mapping of Course Outcomes for Unit V**

CO5

Unit VI	Multimedia Internet of Things	07 Hours
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IoT and Multimedia IoT Architecture: IoT Architecture; M-IoT Architectures: Multi-Agent Based, AI-Based Software-Defined, Big Data Layered; Applications of M-IoT: Road Management System, Multimedia IoT in Industrial Applications, Health Monitoring

#Exemplar/Case Studies Traffic Monitoring System

***Mapping of Course Outcomes for Unit VI** CO6

Learning Resources

Text Books:

1. Tay Vaughan, “Multimedia making it work”, Tata McGraw-Hill, 2011, ISBN: 978-0-07-174850-6 MHID: 0-07-174850-4, eBook print version of this title: ISBN: 978-0-07-174846-9, MHID: 0-07-174846-6
2. Ze-Nian Li, Mark S. Drew and Jiang chuan Liu, “Fundamentals of Multimedia”, Second Edition, Springer, 2011, ISSN 1868-0941 ISSN 1868-095X (electronic), ISBN 978-3-319-05289-2 ISBN 978-3-319-05290-8 (eBook), DOI 10.1007/978-3-319-05290-8, Pearson Education, 2009.

Reference Books:

1. Ali Nauman et al. “Multimedia Internet of Things: A Comprehensive Survey”, Special Section on Mobile Multimedia: Methodology and Applications, IEEE Access, Volume 8, 2020
2. Kelly S. Hale (Editor), Kay M. Stanney (Editor). 2014. Handbook of Virtual Environments: Design, Implementation, and Applications, Second Edition (Human Factors and Ergonomics) ISBN-13: 978-1466511842. Amazon

e-Books :

1. https://users.dimi.uniud.it/~antonio.dangelo/MMS/materials/Fundamentals_of_Multimedia.pdf
2. <https://mu.ac.in/wp-content/uploads/2021/04/Multimedia.pdf>
3. https://www.baschools.org/pages/uploaded_files/chap13.pdf

MOOC Courses Links:

- <https://nptel.ac.in/courses/117105083>

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



Savitribai Phule Pune University

Fourth Year of Computer Engineering (2019 Course)

410244(C): Cyber Security and Digital Forensics

Teaching Scheme: TH: 03 Hours/Week	Credit 03	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks
Prerequisite Courses: Computer Networks and Security(310244), Information Security(310254(A))		
Companion Course: 410246: Laboratory Practice IV		
Course Objectives: • To enhance awareness cyber forensics. • To understand issues in cyber crime and different attacks • To understand underlying principles and many of the techniques associated with the digital forensic practices • To know the process and methods of evidence collection • To analyze and validate forensic data collected. • To apply digital forensic knowledge to use computer forensic tools and investigation report writing.		
Course Outcomes: At the end of the course, the student should be able to: CO1: Analyze threats in order to protect or defend it in cyberspace from cyber-attacks. CO2: Build appropriate security solutions against cyber-attacks. CO3:Underline the need of digital forensic and role of digital evidences. CO4: Explain rules and types of evidence collection CO5: Analyze, validate and process crime scenes CO6: Identify the methods to generate legal evidence and supporting investigation reports.		
Course Contents		
Unit 1	Introduction to Cyber Security	06 Hours
Introduction and Overview of Cyber Crime, Nature and Scope of Cyber Crime, Types of Cyber Crime: crime against an individual, Crime against property, Cyber extortion, Drug trafficking, cyber terrorism. Need for Information security, Threats to Information Systems, Information Assurance, Cyber Security, and Security Risk Analysis.		
#Exemplar/Case Studies	Data Breach Digest – Perspective & Reality : http://verizonenterprise.com/databreachdigest	
*Mapping of Course Outcome for Unit I	CO1	
Unit 2	Cyber Crime Issues and Cyber attacks	06 Hours
Unauthorized Access to Computers, Computer Intrusions, Viruses, and Malicious Code, Internet Hacking and Cracking, Virus and worms, Software Piracy, Intellectual Property, Mail Bombs, Exploitation, Stalking and Obscenity in Internet, Cybercrime prevention methods, Application security (Database, E-mail, and Internet), Data Security Considerations-Backups, Archival Storage and Disposal of Data, Security Technology-Firewall and VPNs, Hardware protection mechanisms, OS Security		
#Exemplar/Case Studies	Cyber Stalking types & their cases respectively	
*Mapping of Course Outcome for Unit II	CO2	
Unit 3	Introduction to Digital Forensics	06 Hours
What is Computer Forensics?, Use of Computer Forensics in Law Enforcement, Computer Forensics Assistance to Human Resources/Employment Proceedings, Computer Forensics Services, Benefits of Professional Forensics Methodology, Steps taken by Computer Forensics Specialists Types of Computer		

Forensics Technology: Types of Military Computer Forensic Technology, Types of Law Enforcement — Computer Forensic Technology, Types of Business Computer Forensic Technology Computer Forensics Evidence and Capture: Data Recovery Defined, Data Back-up and Recovery, The Role of Back-up in Data Recovery, The Data-Recovery Solution.		
#Exemplar/Case Studies	Demonstrate practice Linux networking security recovery commands.& Study Tools viz; FTK & The Sleuth Kit	
*Mapping of Course Outcome for Unit III	CO3	
Unit 4	Evidence Collection and Data Seizure	06 Hours
Why Collect Evidence? Collection Options ,Obstacles, Types of Evidence — The Rules of Evidence, Volatile Evidence, General Procedure, Collection and Archiving, Methods of Collection, Artifacts, Collection Steps, Controlling Contamination: The Chain of Custody Duplication and Preservation of Digital Evidence: Preserving the Digital Crime Scene — Computer Evidence Processing Steps, Legal Aspects of Collecting and Preserving Computer Forensic Evidence Computer Image Verification and Authentication: Special Needs of Evidential Authentication, Practical Consideration, Practical Implementation.		
#Exemplar/Case Studies	Understand how computer forensics works by visiting: http://computer.howstuffworks.com/computer-forensic.htm/printable (23 December 2010)	
*Mapping of Course Outcome for Unit IV	CO4	
Unit 5	Computer Forensics analysis and validation	06 Hours
Determining what data to collect and analyze, validating forensic data, addressing data-hiding techniques, and performing remote acquisitions Network Forensics: Network forensics overview, performing live acquisitions, developing standard procedures for network forensics, using network tools, examining the honeynet project. Processing Crime and Incident Scenes: Identifying digital evidence, collecting evidence in private-sector incident scenes, processing law enforcement crime scenes, preparing for a search, securing a computer incident or crime scene, seizing digital evidence at the scene, storing digital evidence, obtaining a digital hash, reviewing a case		
#Exemplar/Case Studies	Discuss cases under Financial Frauds, Matrimonial Frauds, Job Frauds, Spoofing, and Social media. Then write down safety tips, precautionary measures for the discussed fraud cases.	
*Mapping of Course Outcomes for Unit V	CO5	
Unit 6	Current Computer Forensic tools	06 Hours
Evaluating computer forensic tool needs, computer forensics software tools, computer forensics hardware tools, validating and testing forensics software E-Mail Investigations: Exploring the role of e-mail in investigation, exploring the roles of the client and server in e-mail, investigating e-mail crimes and violations, understanding e-mail servers, using specialized e-mail forensic tools.		
#Exemplar/Case Studies	Install Kali Linux & practice following examples: 1. https://www.youtube.com/watch?time_continue=6&v=MZXZctqIU-w&feature=emb_logo	
*Mapping of Course Outcome for Unit VI	CO6	
Learning Resources		
Text Books: 1. John R. Vacca, “Computer Forensics”, Computer Crime Investigation Firewall Media, New Delhi. 2. Nelson, Phillips Enfinger, Steuart, “Computer Forensics and Investigations”, CENGAGE Learning		
Reference Books: 1. Keith J. Jones, Richard Beitiich, Curtis W. Rose, “Real Digital Forensics”, Addison-		

Wesley Pearson Education

2. Tony Sammes and Brian Jenkinson, “Forensic Compiling”, A Tractitioneris Guide, Springer International edition.

3. Christopher L.T. Brown, “Computer Evidence Collection & Presentation”, Firewall Media.

4. Jesus Mena, “Homeland Security, Techniques & Technologies”, Firewall Media.

e books:

1. <https://www.pdfdrive.com/computer-forensics-investigating-network-intrusions-and-cyber-crime-e15858265.html>

2. <https://dokumen.pub/handbook-of-computer-crime-investigation-forensic-tools-and-technology-1stnbsped-0121631036-9780121631031.html>

3. Massachusetts Institute of Technology Open Courseware: <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-858-computer-systems-security-fall-2014/>

MOOC Courses Links:

- MIT Open CourseWare: <https://ocw.mit.edu/courses/>

@The CO-PO Mapping Matrix

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



Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course)
410244(D): Object oriented Modeling and Design

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

Prerequisite Courses: Software Engineering (210245)

Companion Course: Laboratory Practice IV (410247)

Course Objectives:

- Describe the concepts involved in Object-Oriented modelling and their benefits.
- Demonstrate concept of use-case model, sequence model and state chart model for a given problem.
- Explain the facets of the unified process approach to design and build a Software system.
- Translate the requirements into implementation for Object Oriented design.
- Choose an appropriate design pattern to facilitate development procedure. Select suitable design pattern depending on nature of application.
- To describe Designing and Management of Patterns.

Course Outcomes:

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

CO1: Describe the concepts of object-oriented and basic class modelling.

CO2: Draw class diagrams, sequence diagrams and interaction diagrams to solve problems.

CO3: Choose and apply a befitting design pattern for the given problem

CO4: To Analyze applications, architectural Styles & software control strategies

CO5: To develop Class design Models & choose Legacy Systems.

CO6: To Understand Design Patterns

Course Contents

Unit I	Introduction To Modeling	06 Hours
What is Object Orientation? What is OO development? OO themes; Evidence for usefulness of OO development; OO modeling history Modeling as Design Technique: Modeling; abstraction; The three models. Class Modeling: Object and class concepts; Link and associations concepts; Generalization and inheritance; A sample class model; Navigation of class models; Practical tips.		
#Exemplar/Case Studies	Case Study of ATM System	
*Mapping of Course Outcomes for Unit I	CO1	
Unit II	Advanced Class Modeling and State Modeling	06 Hours
Advanced object and class concepts; Association ends; N-ary associations; Aggregation; Abstract classes; Multiple inheritance; Metadata; Reification; Constraints; Derived data; Packages; Practical tips. State Modeling: Events, States, Transitions and Conditions; State diagrams; State diagram behavior; Practical tips.		

<u>#Exemplar/Case Studies</u>	Case Study of Train Reservation System	
<u>*Mapping of Course Outcomes for Unit II</u>	CO2	
Unit III	Advanced State Modeling and Interaction Modeling	06 Hours
Advanced State Modeling: Nested state diagrams; Nested states; Signal generalization; Concurrency; A sample state model; Relation of class and state models; Practical tips. Interaction Modeling: Use case models; Sequence models; Activity models. Use case relationships; Procedural sequence models; Special constructs for activity models.		
<u>#Exemplar/Case Studies</u>	Case Study of Coffee Vending Machine	
<u>*Mapping of Course Outcomes for Unit III</u>	CO2, C03	
Unit IV	User Application Analysis : System Design	06 Hours
Application Analysis: Application interaction model; Application class model; Application state model; Adding operations. Overview of system design; Estimating performance; Making a reuse plan; Breaking asystem in to sub-systems; Identifying concurrency; Allocation of sub-systems; Management of datastorage; Handling global resources; Choosing a software control strategy; Handling boundary conditions; Setting the trade-off priorities; Common architectural styles; Architecture of the ATM system as the example		
<u>#Exemplar/Case Studies</u>	Case System of ATM System	
<u>*Mapping of Course Outcomes for Unit IV</u>	CO3, CO4	
Unit V	Class Design ,Implementation Modeling, Legacy Systems	06 Hours
Class Design: Overview of class design; Bridging the gap; Realizing use cases; Designing algorithms; Recursing downwards, Refactoring; Design optimization; Reification of behavior; Adjustment of inheritance; Organizing a class design; ATM example. Implementation Modeling: Overview of implementation; Fine-tuning classes; Fine-tuning generalizations; Realizing associations; Testing. Legacy Systems: Reverse engineering; Building the class models; Building the interaction model; Building the state model; Reverse engineering tips; Wrapping; Maintenance		
<u>#Exemplar/Case Studies</u>	Case study of College Library System	
<u>*Mapping of Course Outcomes for Unit V</u>	CO4, CO5	
Unit VI	Design Pattern	06 Hours
What is a pattern and what makes a pattern? Pattern categories; Relationships between patterns; Patterndescription Communication Patterns: Forwarder-Receiver; Client-Dispatcher-Server; Publisher-Subscriber. Management Patterns: Command processor; View handler. Idioms: Introduction; what can idioms provide? Idiomsand style; Where to find idioms; Counted Pointer example		

#Exemplar/Case Studies

Design Pattern for Any suitable System

***Mapping of Course Outcomes for Unit VI**

CO6

Learning Resources**Text Books:**

1. Michael Blaha, James Rumbaugh, “Object-Oriented Modeling and Design with UML”, 2nd Edition, Pearson Education, 2005.
2. Frank Buchmann, Regine Meunier, Hans Rohnert, Peter Sommerlad, Michael Stal, “Pattern-Oriented Software Architecture, A System of Patterns”, Volume 1, John Wiley and Sons, 2007

Reference Books:

1. Grady Booch et al, “Object-Oriented Analysis and Design with Applications”, 3rd Edition, Pearson Education, 2007
2. Brahma Dathan, Sarnath Ramnath, “Object-Oriented Analysis, Design, and Implementation”, Universities Press, 2009
3. Hans-Erik Eriksson, Magnus Penker, Brian Lyons, David Fado, “UML 2 Toolkit”, Wiley-Dreamtech India, 2004
4. Simon Bennett, Steve McRobb and Ray Farmer, “UML 2 Toolkit, Object-Oriented Systems Analysis and Design Using UML, 2nd Edition, Tata McGraw-Hill, 2002

e-Books :

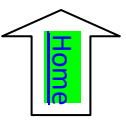
1. [Object Oriented Modeling and Design - https://www.pdfdrive.com/object-oriented-design-and-modeling-d10014860.html](https://www.pdfdrive.com/object-oriented-design-and-modeling-d10014860.html)
2. <https://www.gopalancolleges.com/gcem/course-material/computer-science/course-plan/sem-VII/object-oriented-modeling-and-design-10CS71.pdf>

MOOC Lectures Links:

- <https://nptel.ac.in/courses/106105153>

@The CO-PO Mapping Matrix

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



Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course)
410244(E): Digital Signal Processing

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

Prerequisite Courses: Engineering Mathematics III(207003)

Companion Course: Laboratory Practice IV(410247)

Course Objectives:

- To Study and understand representation and properties of signals and systems.
- To learn methodology to analyze signals and systems
- To study transformed domain representation of signals and systems
- To explore Design and analysis of Discrete Time (DT) signals and systems
- To Understand Design of filters as DT systems
- To get acquainted with the DSP Processors and DSP applications

Course Outcomes:

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

CO1: Understand the mathematical models and representations of DT Signals and Systems
 CO2: Apply different transforms like Fourier and Z-Transform from applications point of view.

CO3: Understand the design and implementation of DT systems as DT filters with filter structures and different transforms.

CO4: Demonstrate the knowledge of signals and systems for design and analysis of systems

CO5: Apply knowledge and use the signal transforms for digital processing applications

CO6: To understand Filtering and Different Filter Structures

Course Contents

Unit I	Signals and Systems	08 Hours
Continuous time (CT), Discrete-time (DT) and Digital signals, Basic DT signals and Operations. Discrete-time Systems, Properties of DT Systems and Classification, Linear Time Invariant (LTI) Systems, Impulse response, Linear convolution, Linear constant coefficient difference equations, FIR and IIR systems, Periodic Sampling, Relationship between Analog and DT frequencies, Aliasing, Sampling Theorem, A to D conversion Process: Sampling, quantization and encoding		
#Exemplar/Case Studies	Audio/Music Sampling	
*Mapping of Course Outcomes for Unit I	CO1	
Unit II	Frequency Domain Representation of Signal	08 Hours
Introduction to Fourier Series, Representation of DT signal by Fourier Transform (FT), Properties of FT: Linearity, periodicity, time shifting, frequency shifting, time reversal, differentiation, convolution theorem, windowing theorem Discrete Fourier Transform (DFT), DFT and FT, IDFT, Twiddle factor, DFT as linear transformation matrix, Properties of DFT, circular shifting, Circular Convolution, DFT as Linear filtering, overlap save and add, DFT spectral		

leakage		
<u>#Exemplar/Case Studies</u>	Spectral Analysis using FFT	
<u>*Mapping of Course Outcomes for Unit II</u>	CO1	
Unit III	Fast Fourier Transform (FFT) and Z-Transform(ZT)	08 Hours
Effective computation of DFT, Radix-2 FFT algorithms: DIT FFT, DIF FFT, Inverse DFT using FFT, Z-transform (ZT), ZT and FT, ZT and DFT, ROC and its properties, ZT Properties, convolution, initial value theorem, Rational ZT, Pole Zero Plot, Behavior of causal DT signals, Inverse Z Transform (IZT): power series method, partial fraction expansion (PFE) , Residue method.		
<u>#Exemplar/Case Studies</u>	Discrete Hilbert Algorithm	
<u>*Mapping of Course Outcomes for Unit III</u>	CO2	
Unit IV	Analysis of DT - LTI Systems	08 Hours
System function $H(z)$, $H(z)$ in terms of Nth order general difference equation, all pole and all zero systems, Analysis of LTI system using $H(z)$, Unilateral Z-transform: solution of difference equation, Impulse and Step response from difference equation, Pole zero plot of $H(z)$ and difference equation, Frequency response of system, Frequency response from pole-zero plot using Simple geometric construction.		
<u>#Exemplar/Case Studies</u>	Schur Algorithm	
<u>*Mapping of Course Outcomes for Unit IV</u>	CO3	
Unit V	Digital Filter Design	08 Hours
Concept of filtering, Ideal filters and approximations, specifications, FIR and IIR filters, Linear phase response, FIR filter Design: Fourier Series method, Windowing method, Gibbs Phenomenon, desirable features of windows, Different window sequences and its analysis, Design examples IIR filter design: Introduction, Mapping of S-plane to Z-plane, Impulse Invariance method, Bilinear Z transformation (BLT) method, Frequency Warping, Pre-warping, Design examples, Comparison of IIR and FIR Filters.		
<u>#Exemplar/Case Studies</u>	Realization of an Analogue Second-order Differentiator	
<u>*Mapping of Course Outcomes for Unit V</u>	CO5	
Unit VI	Filter Structures and DSP Processors	08 Hours
Filter Structures for FIR Systems: direct form, cascade form, structures for linear phase FIR Systems, Examples, Filter structures for IIR Systems: direct form, cascade form, parallel form, Examples DSP Processors: ADSP 21XX Features, comparison with conventional processor, Basic Functional Block diagram, SHARC DSP Processor Introduction to OMAP (Open Multimedia Application Platform).		
<u>#Exemplar/Case Studies</u>	Architectures and Design techniques for energy efficient embedded DSP	

Faculty of Engineering	and multimedia processing
*Mapping of Course Outcomes for Unit VI	CO6

Learning Resources

Text Books:

1. Proakis J, Manolakis D, "Digital Signal Processing", 4th Edition, Pearson Education, ISBN9788131710005
2. Oppenheim A, Schafer R, Buck J, "Discrete time Signal Processing", 2nd Edition, Pearson Education, ISBN 9788131704929

Reference Books:

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

e-Books :

1. An Introduction to Digital Signal Processing: A Focus on Implementation
https://www.riverpublishers.com/pdf/ebook/RP_E9788792982032.pdf

MOOC Courses Links:

- Digital signal Processing Introduction- <https://nptel.ac.in/courses/117102060>

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



Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course)
Elective V

410245(A): Information Retrieval

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

Prerequisite Courses: Database Management Systems(310241)

Companion Course: Laboratory Practice IV(410247)

Course Objectives:

- To study basic concepts of Information Retrieval.
- To study concepts of Indexing for Information Retrieval.
- To analyze the performance of information retrieval using advanced techniques such as classification, clustering, and filtering over multimedia.
- To provide comprehensive details about various Evaluation methods.
- To understand the changes necessary to transfer a Basic IR system into large scale search service system.
- To understand Parallel Information retrieval and Web structures .

Course Outcomes:

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

- CO1:Implement the concept of Information Retrieval
 CO2:Generate quality information out of retrieved information
 CO3:Apply techniques such as classification, clustering, and filtering over multimedia to analyze the information
 CO4:Evaluate and analyze retrieved information
 CO5:Understand the data in various Application and Extensions of information retrieval
 CO6: Understand Parallel information retrieving and web structure.

Course Contents

Unit I	Introduction , Basic techniques, &Token	07 Hours
Introduction: The IR System, The Software Architecture Of The IR System. Basic IR Models: Boolean Model, TF-IDF (Term Frequency/Inverse Document Frequency) Weighting, Vector Model, Probabilistic Model and Latent Semantic Indexing Model. Basic Tokenizing: Simple Tokenizing, Stop-Word Removal and Stemming.		
#Exemplar/Case Studies	A Case Study Of Onitsha Divisional Library Which Aims At Finding The Causes And Solutions To The Problems Of Information Retrieval Methods By The Library.	
*Mapping of Course Outcomes for Unit I	CO 1	
Unit II	Static Inverted Indices and Query Processing	07 Hours

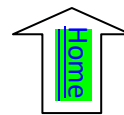
Static Inverted Indices :Inverted Index Construction, Index Components and Index Life Cycle, The Dictionary : Sort-based dictionary ,Hash-based dictionary, Interleaving Dictionary and Postings Lists, Index Construction: Different types of Index Construction, In-Memory Index Construction, Sort-Based Index Construction, Merge-Based Index Construction, Disk-Based Index Construction), Other types of Indices. Query Processing : Query Processing for Ranked Retrieval , Document-at-a-Time QueryProcessing, Term-at-a-Time Query Processing, Pre-computing Score Contributions, Impact Ordering) Query optimization, Lightweight Structure : Generalized Concordance Lists, Operators, Implementation & Examples		
<u>#Exemplar/CaseStudies</u>	Match the search statement with the stored database	
<u>*Mapping of Course Outcomes for Unit II</u>	CO2	
Unit III	Index Compression and Dynamic Inverted Indices	07 Hours
General-Purpose Data Compression, Data Compression : Modeling and Coding, Huffman Coding, Arithmetic Coding, Symbolwise Text Compression Compressing Postings Lists: Nonparametric Gap Compression, Parametric Gap Compression, Context-Aware Compression Methods, Index Compression for High Query Performance, Compression Effectiveness, DecodingPerformance, Document Reordering. Dynamic Inverted Indices: Incremental Index Updates, Contiguous Inverted Lists, Noncontiguous Inverted, Document Deletions: Invalidation List, Garbage Collection, Document Modifications,		
<u>#Exemplar/Case Studies</u>	Translating Short Segments with NMT: A Case Study in English-to-Hindi	
<u>*Mapping of Course Outcomes for Unit III</u>	CO2	
Unit IV	Probabilistic Retrieval and Language Modeling & Related Methods , Categorization & Filtering	07 Hours
Probabilistic Retrieval: Mdeling Relevance, The Binary Independence Model, Term Frequency, Document Length:BM25, Relevance Feedback, Field Weights Language Modeling and Related Methods: Generating Queries from Documents, Language Models and Smoothing, Ranking with Language Models, Divergence from Randomness, PassageRetrieval and Ranking Categorization and Filtering: Detailed Examples, Classification, Linear, Similarity- Based, Probabilistic Classifiers, Generalized Linear Models. Information-Theoretic Model. E-Mail on the Move: Categorization, Filtering, and Alerting on Mobile Devices with the if Mail Prototype		
<u>#Exemplar/Case Studies</u>	E-Mail on the Move: Study of E-mail Categorization, Filtering, and Alerting on Mobile Devices	

<u>*Mapping of Course Outcomes for Unit IV</u>	CO3	
Unit V	Measuring Effectiveness and Measuring Efficiency	07 Hours
Measuring Effectiveness - Traditional effectiveness measure, The Text Retrieval Conference (TREC), Using statistics in evaluation, Minimizing adjudication Effort, Nontraditional effectiveness measures		
Measuring Efficiency – Efficiency criteria, Query Scheduling, Caching, Introduction to Redis and Memcached		
<u>#Exemplar/Case Studies</u>	Study of API Handling	
<u>*Mapping of Course Outcomes for Unit V</u>	CO 4	
Unit VI	Parallel Information retrieval , Web Search	07 Hours
Parallel Information retrieval - Parallel Query Processing, MapReduce		
Web Search- The structure of the web, Quieres and Users, Static ranking, Dynamic ranking, Evaluation web search, Web Crawlers, Web crawler libraries, Python Scrapy, BeautifulSoup		
<u>#Exemplar/Case Studies</u>	Study of Google Map / Facebook information retrieval	
<u>*Mapping of Course Outcomes for Unit VI</u>	CO 5 , CO6	
Learning Resources		
Text Books:		
1. S. Buttcher, C. Clarke and G. Cormack, “Information Retrieval: Implementing and Evaluating Search Engines” MIT Press, 2010, ISBN: 0-408-70929-4. 2. C. Manning, P. Raghavan, and H. Schütze, “Introduction to Information Retrieval”, Cambridge University Press, 2008, -13: 9780521865715 3. Ricardo Baeza , Yates and Berthier Ribeiro Neto, “Modern Information Retrieval: The Concepts and Technology behind Search”, 2nd Edition, ACM Press Books 2011. 4. Bruce Croft, Donald Metzler and Trevor Strohman, “Search Engines: Information Retrieval in Practice”, 1st Edition Addison Wesley, 2009, ISBN: 9780135756324		
Reference Books:		
1. C.J. Rijsbergen, "Information Retrieval", (http://www.dcs.gla.ac.uk/Keith/Preface.html) 2. W.R. Hersh, “Information Retrieval: A Health and Biomedical Perspective”, Springer, 2002. 3. G. Kowalski, M.T. Maybury. "Information storage and Retrieval System" , Springer, 2005 4. W.B. Croft, J. Lafferty, “Language Modeling for Information Retrieval”, Springer, 2003		
e-Books :		
1. Information Retrieval- www.informationretrieval.org		

MOOC Courses Links:

- <https://nptel.ac.in/courses/117102060>

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



Savitribai Phule Pune University			Home
Fourth Year of Computer Engineering (2019 Course)			
Elective V			
410245(B): GPU Programming and Architecture			
Teaching Scheme: TH: 03 Hours/Week	Credit 03	Examination Scheme: Mid-Semester (TH) : 30 Marks End-Sem (TH): 70 Marks	
Prerequisites Courses: Computer Graphics(210244)			
Companion Course: Laboratory Practice IV(410247)			
Course Objectives:			
- To Understand Graphics Processing Unit (GPU) Concepts. - To understand the basics of GPU architectures - To write programs for massively parallel processors - To understand the issues in mapping algorithms for GPUs - To introduce different GPU programming models - To examine the architecture and capabilities of modern GPUs.			
Course Outcomes:			
After completion of the course, students should be able to-			
CO1: Describe GPU architecture			
CO2: Write programs using CUDA, identify issues and debug them.			
CO3: Implement efficient algorithms in GPUs for common application kernels, such as matrix multiplication			
CO4: Write simple programs using OpenCL			
CO5: Identify efficient parallel programming patterns to solve problems			
CO6: Explore the modern GPUs architecture and it's Applications.			
Course Contents			
Unit I	Introduction to Graphics Processing Unit (GPU)		07 Hours
Evolution of GPU architectures – Understanding Parallelism with GPU –Typical GPU Architecture – CUDA Hardware Overview – Threads, Blocks, Grids, Warps, Scheduling – Memory Handling with CUDA: Shared Memory, Global Memory, Constant Memory and Texture Memory.			
#Exemplar/Case Studies	Review of traditional Computer Architecture		
*Mapping of Course Outcomes for Unit I	CO 1		
Unit II	Cuda Programming		07 Hours
Using CUDA – Multi GPU – Multi GPU Solutions – Optimizing CUDA Applications: Problem Decomposition, Memory Considerations, Transfers, Thread Usage, Resource Contentions.			
#Exemplar/Case Studies	Write basic CUDA programs.		
*Mapping of Course Outcomes for Unit II	CO 2		
Unit III	Programming Issues		07 Hours

Common Problems: CUDA Error Handling, Parallel Programming Issues, Synchronization, Algorithmic Issues, Finding and Avoiding Errors.

#Exemplar/Case Studies	Study of various CUDA errors
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*Mapping of Course Outcomes for Unit III	CO 3
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Unit IV	Opencl Basics	07 Hours
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OpenCL Standard, Kernels, Host Device Interaction, Execution Environment, Memory Model, Basic OpenCL Examples.

#Exemplar/Case Studies	Write OpenCL basic program
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*Mapping of Course Outcomes for Unit IV	CO 4
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Unit V	Algorithms on GPU	07 Hours
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Parallel Patterns: Convolution, Prefix Sum, Sparse Matrix – Matrix Multiplication – Programming Heterogeneous Cluster

#Exemplar/Case Studies	Describe multi-dimensional mapping of dataspace.
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*Mapping of Course Outcomes for Unit V	CO 5
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Unit VI	OpenCL and Application Design	07 Hours
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OpenCL for Heterogeneous Computing, Application Design: Efficient Neural Network Training/Inferencing

#Exemplar/Case Studies	Describe OpenCL for Heterogeneous computing
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*Mapping of Course Outcomes for Unit VI	CO6
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Learning Resources

Text Books:

1. Shane Cook, “CUDA Programming: A Developer’s Guide to Parallel Computing with GPUs (Applications of GPU Computing)”, First Edition, Morgan Kaufmann, 2012.
2. David R. Kaeli, Perhaad Mistry, Dana Schaa, Dong Ping Zhang, “Heterogeneous computing with OpenCL”, 3rd Edition, Morgan Kauffman, 2015.
3. Benedict Gaster, Lee Howes, David R. Kaeli, “Heterogeneous Computing with OpenCL”

Reference Books :

1. Nicholas Wilt, “CUDA Handbook: A Comprehensive Guide to GPU Programming”, Addison –Wesley, 2013.
2. Jason Sanders, Edward Kandrot, “CUDA by Example: An Introduction to General Purpose GPU Programming”, Addison – Wesley, 2010.
3. David B. Kirk, Wen-mei W. Hwu, “Programming Massively Parallel Processors “, A Hands-on Approach, Third Edition, Morgan Kaufmann, 2016.
4. http://www.nvidia.com/object/cuda_home_new.html
5. <http://www.openCL.org>

e-Books :

1. <https://www.perlego.com/book/1418742/cuda-handbook-a-comprehensive-guide-to-gpu-programming-the-pdf>

NPTEL/YouTube video lecture link

- https://onlinecourses.nptel.ac.in/noc20_cs41/preview

@The CO-PO Mapping Matrix

CO/ PO	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO 10	PO1 1	PO1 2
CO1	1	2	1	1	2	-	1	-	-	-	-	-
CO2	1	2	2	2	2	-	-	-	-	-	-	-
CO3	1	2	2	2	2	-	-	-	-	-	-	-
CO4	1	2	2	2	2	-	-	-	-	-	-	-
CO5	1	2	2	2	2	-	-	-	-	-	-	-
CO6	1	2	2	1	2	-	-	-	-	-	-	-



Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course)
Elective V
410245(C): Mobile Computing

Teaching Scheme: TH: 3 Hours/Week	Credit 3	Examination Scheme:100 Mid-Semester (TH) : 30 End- Sem (TH): 70
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Prerequisites Courses: Computer Networks and Security(310244)

Companion Course: Laboratory Practice IV(410247)

Course Objectives:

- To introduce the basic concepts and principles in mobile computing. This includes major techniques involved, and networks & systems issues for the design and implementation of mobile computing systems and applications
- To demonstrate the protocols of mobile communication.
- To know GSM architecture and support services
- To Study on location, handoff management and wireless fundamentals.
- To summarize VLR and HLR identification algorithms
- To learn current technologies being used on field and design and development of various network protocol using simulation tools.

Course Outcomes:

CO1: Develop a strong grounding in the fundamentals of mobile Networks
 CO2: Apply knowledge in MAC, Network, and Transport Layer protocols of Wireless Network
 CO3: Illustrate Global System for Mobile Communications
 CO4: Use the 3G/4G technology based network with bandwidth capacity planning, VLR and HLR identification algorithms
 CO5: Classify network and transport layer of mobile communication
 CO6: Design & development of various wireless network protocols using simulation tools

Course Contents

Unit I	Introduction to Mobile Computing	07 Hours
Introduction to Mobile computing, Constraints in mobile computing, Application of mobile computing, Generations of mobile wireless 1G to 5G, Future of mobile computing, Radio frequency Technology, Public Switched Telephone network, (PSTN), Public Communication service (PCS), PCS Architecture, , Blue tooth, Ad-hoc Networks.		
#Exemplar/Case Studies	5G Network , Spectrum sharing for D2D communication in 5G cellular networks	
*Mapping of Course Outcomes for Unit I	CO1	
Unit II	Mobile Wireless protocols	07 Hours
Introduction of WAP, WAP applications, WAP Architecture, WAP Protocol Stack, Challenges in WAP . Introduction, Benefits, Difference, Routing protocols for ad hoc wireless networks: DSDV and AODV, Wireless Application protocols: MAC,SDMA, FDMA,TDMA,CDMA, Cellular Wireless Networks. Wireless Communication: Cellular systems, Frequency Management and Channel Assignment Types of handoff		

and their characteristics.

#Exemplar/Case Studies	IPoC: A New Core Networking Protocol for 5G Networks.	
*Mapping of Course Outcomes for Unit II	CO2	
Unit III	Global System for Mobile Communication	07 Hours
Global System for Mobile Communications (GSM) architecture , Mobile Station, Base Station System, Switching subsystem, Security, Data Services, HSCSD, GPRS - GPRS system and protocol architecture 2.3 UTRAN, UMTS core network; Improvements on Core Network, 802.11 Architecture 802.11a, 802.11b standard		
#Exemplar/Case Studies	5G mobile communications	
*Mapping of Course Outcomes for Unit III	CO3	
Unit IV	GSM Networking Signaling and Mobile Management	07 Hours
GSM MAP Service framework, MAP protocol machine, GSM location management, Transaction management, Mobile database, Introduction to location management HLR and LR VLR and HLR Failure restoration, VLR identification algorithm, O-I, O-II algorithm etc. Overview of handoff process; Factors affecting handoffs and performance evaluation metrics; Handoff strategies; Different types of handoffs (soft, hard, horizontal, vertical).		
#Exemplar/Case Studies	5G Mobility Management , Micro Mobility: CellularIP, HAWAII, HMIPv6	
*Mapping of Course Outcomes for Unit IV	CO4	
Unit V	Mobile Network and Transport Layers	07 Hours
Mobile IP , IP packet delivery, Tunnelling and encapsulation, IPv6, DHCP, Vehicular Ad Hoc networks (VANET), MANET , Traditional TCP, Snooping TCP, Mobile TCP, 3G wireless network, Wireless Application Protocol, WDP WTP, WML, WTA architecture, Cellular IP		
#Exemplar/Case Studies	5G Network and Transport Layers	
*Mapping of Course Outcomes for Unit V	CO5	
Unit VI	Wireless Application Protocol (WAP) and current trends	07 Hours
WAP model, WAP Gateway, WAP protocol, WAP UAProf and Caching, Wireless Bearer for WAP, WAP Developer Toolkits, Introduction to D2D communications; High level requirements for 5G architecture; Introduction to the radio resource management, power control and mode selection problems; Millimeter wave communication in 5G, Introduction to mobile cloud computing and its Applications		

#Exemplar/Case Studies	Long-Term Evolution (LTE) of 3GPP
*Mapping of Course Outcomes for Unit VI	CO6

Learning Resources

Text Books:

1. Jochen Schiller, “Mobile Communications”, Pearson Education, 2009.
2. Martin Sauter, “3G, 4G and Beyond: Bringing Networks, Devices and the Web Together”, 2012, ISBN-13: 978-1118341483
3. Raj Kamal, “Mobile Computing”, 2/e, Oxford University Press

Reference Books :

1. William Stallings, “Wireless Communications & Networks”, Second Edition, Pearson Education
2. Christopher Cox, “An Introduction to LTE: LTE, LTE-Advanced, SAE and 4G Mobile Communications”, Wiley publications
3. Andrea Goldsmith, “Wireless Communications”, Cambridge University Press, 2012.

e-Books :

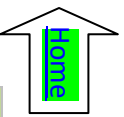
1. <http://www.dauniv.ac.in/downloads/Mobilecomputing/Microsoft%20%20MobileCompChap02L02HandhelCompandMobileOSes.pdf>

MOOC Courses Links :

- <https://nptel.ac.in/courses/106106147>

@The CO-PO Mapping Matrix

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



Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course)
Elective V

410245 (D): Software Testing and Quality Assurance

Teaching Scheme: TH: 03 Hours/Week	Credit 03	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks
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Prerequisite Courses: Software Engineering (210253), Software Project Management(310245(D))

Companion Course: Lab Practice IV

Course Objectives:

- Introduce basic concepts of software testing.
- Understand the best way to increase the effectiveness, test coverage, and execution speed in software testing.
- Understand white box, block box, object oriented, web based and cloud testing.
- Understand the importance of software quality and assurance software systems development.
- Know in details automation testing and tools used for automation testing.
- To learn and understand the combination of practices and tools that are designed to help QA professionals test more efficiently.

Course Outcomes:

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

CO1: Describe fundamental concepts in software testing such as manual testing, automation testing and software quality assurance.

CO2: Design and Develop project test plan, design test cases, test data, and conduct test operations.

CO3: Apply recent automation tool for various software testing for testing software.

CO4: Apply different approaches of quality management, assurance, and quality standard to software system.

CO5: Apply and analyze effectiveness Software Quality Tools.

CO6: Apply tools necessary for efficient testing framework.

Course Contents

Unit I	Introduction to Software Testing	07 Hours
Introduction: historical perspective, Definition, Core Components, Customers suppliers and process, Objectives of Testing, Testing and Debugging, Need of Testing, Quality Assurance and Testing, Why Software has Errors, Defects and Failures and its Causes and Effects, Total Quality Management(TQM), Quality practices of TQM, Quality Management through- Statistical process Control, Cultural Changes, Continual Improvement cycle, Benchmarking and metrics, Problem Solving Techniques and Software Tools. Software Quality, Constraints of Software product Quality assessment, Quality and Productivity Relationship, Requirements of Product, Software Development Process, Types of Products, Software Development Lifecycle Models, Software Quality Management, Processes related to Software Quality, Quality Management System's Structure, Pillars of Quality Management System, Important aspects of quality management.		
#Exemplar/Case Studies	1. Offshore delivery model for an Airline Company. 2. SAP test automation CoE for Financial Service Provider.	

<u>*Mapping of Course Outcomes for Unit I</u>		CO1
Unit II	Test Planning and Quality Management	07 Hours
Test Planning –Artifacts & Strategy, Test Organization –Test Manager & Tester Role, Test plan purpose & contents, Test Strategy and Approach, Test cases & Test Data, Test Entry-Exit criteria, Test Execution Schedule, Use case Testing, Scenario Testing, Test Monitoring & Control- Test Metrics –Test Case Productivity, Test case Coverage, Defect Acceptance & Rejection, Test Efficiency, Efforts and Schedule Variance, Test Efforts biasing Factors, Test Report & configuration Management, Quality Assurance Process, Documentation Risk & Issues. Software Quality, Quality Management Importance, Quality Best practices.		
<u>#Exemplar/CaseStudies</u>	1. Online Recommendation System 2. Quality Engineering services for Medical Devices company CaseStudy (cigniti.com)	
<u>*Mapping of Course Outcomes for Unit II</u>		CO2
Unit III	Test Case Design Techniques	07 Hours
Software Testing Methodologies: White Box Testing, Black Box Testing, Grey Box Testing. Test Case Design Techniques: Static Techniques: Informal Reviews, Walkthroughs, Technical Reviews, Inspection. Dynamic Techniques: Structural Techniques: Statement Coverage Testing, Branch Coverage Testing, Path Coverage Testing, Conditional Coverage Testing, Loop Coverage Testing Black Box Techniques: Boundary Value Analysis, Equivalence Class Partition, State Transition Technique, Cause Effective Graph, Decision Table, Use Case Testing, Experienced Based Techniques: Error guessing, Exploratory testing Levels of Testing: Functional Testing: Unit Testing, Integration Testing, System Testing, User Acceptance Testing, Sanity/Smoke Testing, Regression Test, Retest. Non-Functional Testing: Performance Testing, Memory Test, Scalability Testing, Compatibility Testing, Security Testing, Cookies Testing, Session Testing, Recovery Testing, Installation Testing, Adhoc Testing, Risk Based Testing, I18N Testing, L1ON Testing, Compliance Testing. Link: https://www.besanttechnologies.com/training-courses/software-testing-training/manual-testing-training-institute-in-chennai		
<u>#Exemplar/Case Studies</u>	1. Case Study: Manual Testing (Online Marketing SoftwarePlatform) Link: https://www.360logica.com/blog/case-study-manual-testing-online-marketing-software-platform/ 2. Case Study: Decision Table Testing (transferring money online to an account which is already added and approved.)	
<u>*Mapping of Course Outcomes for Unit III</u>		CO3
Unit IV	Software Quality Assurance and Quality Control	07 Hours
Software Quality Assurance: Introduction, Constraints of Software Product Quality Assessment, Quality and Productivity Relationship, Requirements of a Product, Characteristics of Software,		

Software Development Process, Types of Products, Schemes of Criticality Definitions, Software Quality Management, Why Software Has Defects? Processes Related to Software Quality, Quality Management System Structure, Pillars of Quality Management System, Important Aspects of Quality Management.

Software Quality Control: Software quality models, Quality measurement and metrics, Quality plan, implementation and documentation, Quality tools including CASE tools, Quality control and reliability of quality process, Quality management system models, Complexity metrics and Customer Satisfaction, International quality standards – ISO, CMM

<u>#Exemplar/Case Studies</u>	1. Case Study #1 – Android Application Acceptance Test Suite 2. Case Study #2 – API Acceptance Test Suite Link for above case studies - <u>Software Quality Assurance Case Studies - Beta Breakers</u>
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<u>*Mapping of Course Outcomes for Unit IV</u>	CO4
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Unit V	Automation Testing Tools/_Performance Testing Tools	07 Hours
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Automation Testing: What is automation testing, Automated Testing Process, Automation Frameworks, Benefits of automation testing, how to choose automation testing tools. Selenium Automation Tools: Selenium's Tool Suite- Selenium IDE, Selenium RC, Selenium Web driver, Selenium Grid. Automation Tools: SoapUI, Robotic Process Automation (RPA), Tosca, Appium.

[Performance Testing : What is Performance Testing what is use of it? Tools used for performance testing - Apache Jmeter.](#)

<u>#Exemplar/Case Studies</u>	1. Case Study: Cucumber open-source automation testing framework. 2. Case Study: <u>(PDF) Automated Software Testing—A Case Study(researchgate.net)</u>
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<u>*Mapping of Course Outcomes for Unit V</u>	CO5
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Unit VI	Testing Framework	07 Hours
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Testing Framework: Software Quality, Software Quality Dilemma, Achieving Software Quality, Software Quality Assurance Elements of SQA, SQA Tasks, Goals and Metrics, Formal Approaches to SQA, Statistical Software Quality Assurance, Six Sigma for Software Engineering, ISO 9000 Quality Standards, SQA Plan, Total Quality Management, Product Quality Metrics, In process Quality Metrics, Software maintenance, Ishikawa's 7 basic tools, Flow Chart, Checklists, Pareto diagrams, Histogram, Run Charts, Scatter diagrams, Control chart, Cause Effect diagram. Defect Removal Effectiveness and Process.

<u>#Exemplar/Case Studies</u>	1. Case study: Software Quality In Academic Curriculum. 2. Case study: <u>Evaluation of an Automated Testing Framework: A Case Study (scielo.sa.cr)</u>
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<u>*Mapping of Course Outcomes for Unit VI</u>	CO6
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Learning Resources		
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Text Books:

1. M G Limaye, "Software Testing Principles, Techniques and Tools", Tata McGraw Hill, ISBN:9780070139909 0070139903
2. Srinivasan Desikan, Gopal Swamy Ramesh, "Software Testing Principles and Practices", Pearson, ISBN-10: 817758121X

Reference Books:

1. Naresh Chauhan, "Software Testing Principles and Practices", OXFORD, ISBN-10: 0198061846. ISBN-13: 9780198061847
2. Stephen Kan, "Metrics and Models in Software Quality Engineering", Pearson, ISBN-10: 0133988082; ISBN-13: 978-0133988086

e-Books :

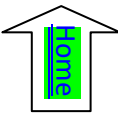
1. M G Limaye, "Software Testing Principles, Techniques and Tools"
https://books.google.co.in/books?id=zUm8My7SiakC&printsec=frontcover&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false
2. Srinivasan Desikan, Gopalswamy Ramesh, "Software Testing Principles and Practices"
https://kupdf.net/queue/software-testing-principles-and-practices-by-srinivasan_5b0ae8eae2b6f51f7d862d26_pdf?queue_id=-1&x=1656562364&z=MTE1LjI0Mi4yNDIuNzA=
3. Naresh Chauhan, "Software Testing Principles and Practice"
<https://pdfcoffee.com/download/se-4-pdf-free.html>

MOOC Courses Links:

- <https://nptel.ac.in/courses/106105150>
- [NPTEL : NOC: Software Testing \(2017\) \(Computer Science and Engineering\) \(digimat.in\)](#)

@The CO-PO Mapping Matrix

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



Savitribai Phule Pune University Fourth Year of Computer Engineering (2019 Course) Elective V 410252(E): Compilers		
Teaching Scheme: TH: 03 Hours/Week	Credit 03	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks
Prerequisite Courses: Theory of Computation(310241), Systems Programming and Operating System310251		
Companion Course : Laboratory Practice IV (410247)-		
Course Objectives: • To aware about language translation theories and compiler design stages • To illustrate the various parser configurations • To exemplify the use of syntax directed translation in intermediate code • To Understand Storage Management and Control Structure Environment . • Learn to develop a Code generator • To demonstrate the numerous optimization methods used in the creation of different optimizing compilers		
Course Outcomes: On completion of the course, student will be able to– CO1: Design and implement a lexical analyzer using LEX tools CO2: Design and implement a syntax analyzer using YACC tools CO3: Understand syntax-directed translation and run-time environment CO4 : Generate intermediate codes for high-level statements. CO5 : Construct algorithms to produce computer code. CO6: Analyze and transform programs to improve their time and memory efficiency		
Course Contents		
Unit I	Notion and Concepts	08 Hours
Introduction to compilers Design issues, passes, phases, symbol table Preliminaries Memory management, Operating system support for compiler, Lexical Analysis Tokens, Regular Expressions, Process of Lexical analysis, Block Schematic, Automatic construction of lexical analyzer using LEX, LEX features and specification.		
#Exemplar/Case Studies	Study of LEX Compiler	
*Mapping of Course Outcomes for Unit	CO1	
Unit II	Parsing	08 Hours

Syntax Analysis CFG, top-down and bottom-up parsers, RDP, Predictive parser, SLR, LR(1), LALR parsers, using ambiguous grammar, Error detection and recovery, automatic construction of parsers using YACC, Introduction to Semantic analysis, Need of semantic analysis, type checking and type conversion.

<u>#Exemplar/Case Studies</u>	Study of YACC
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<u>*Mapping of Course Outcomes for Unit II</u>	CO2
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Unit III	Syntax Translation Schemes	08 Hours
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Syntax Directed Translation - Attribute grammar, S and L attributed grammar, bottom up and top down evaluations of S and L attributed grammar, Syntax directed translation scheme, Intermediate code - need, types: Syntax Trees, DAG, Three-Address codes: Quadruples, Triples and Indirect Triples, Intermediate code generation of declaration statement and assignment statement.

<u>#Exemplar/Case Studies</u>	Applications of Syntax Directed Translation
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<u>*Mapping of Course Outcomes for Unit III</u>	CO3
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Unit IV	Run-time Storage Management	08 Hours
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Storage Management – Static, Stack and Heap, Activation Record, static and control links, parameter passing, return value, passing array and variable number of arguments, Static and Dynamic scope, Dangling Pointers, translation of control structures – if, if-else statement, Switch-case, while, do-while statements, for, nested blocks, display mechanism, array assignment, pointers, function call and return. Translation of OO constructs: Class, members and Methods.

<u>#Exemplar/Case Studies</u>	CARAT - Compiler and runtime based address translation model
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<u>*Mapping of Course Outcomes for Unit IV</u>	CO4
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Unit V	Code Generation	07 Hours
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Code Generation - Issues in code generation, basic blocks, flow graphs, DAG representation of basic blocks, Target machine description, peephole optimization, Register allocation and Assignment, Simple code generator, Code generation from labeled tree, Concept of code generator.

<u>#Exemplar/Case Studies</u>	Code Generator for a Virtual Machine Code based JavaScript Compiler (http://article.nadiapub.com/IJAST/vol119/11.pdf)
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<u>*Mapping of Course Outcomes for Unit V</u>	CO5
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Unit VI	Code Optimization	07 Hours
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Need for Optimization, local, global and loop optimization, Optimizing transformations, compile time evaluation, common sub-expression elimination, variable propagation, code movement, strength reduction, dead code elimination, DAG based local optimization, Introduction to global data flow analysis, Data flow equations and iterative data flow analysis.

#Exemplar/Case Studies

Execution of super-scalar processors

***Mapping of Course Outcomes for Unit VI**

CO6

Learning Resources**Text Books:**

1. V Aho, R Sethi, J D Ullman, "Compilers: Principles, Techniques, and Tools", Pearson Edition, ISBN 81-7758-590-8
2. Dick Grune, Bal, Jacobs, Langendoen, "Modern Compiler Design", Wiley, ISBN 81-265-0418-8

Reference Books:

1. Anthony J. Dos Reis, "Compiler Construction Using Java", JavaCC and Yacc Wiley, ISBN 978-0-470-94959-7
2. K Muneeswaran, "Compiler Design", Oxford University press, ISBN 0-19-806664-3
3. J R Levin, T Mason, D Brown, "Lex and Yacc", O'Reilly, 2000 ISBN 81-7366-061-X

eBooks:

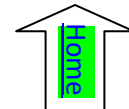
1. Basics of Compiler Design
http://hjemmesider.diku.dk/~torbenm/Basics/basics_lulu2.pdf
2. Modern Compiler Design
<http://160592857366.free.fr/joe/ebooks/ShareData/Modern%20Compiler%20Design%202e.pdf>

MOOC Courses Links:

- <https://nptel.ac.in/courses/106105190>

@The CO-PO Mapping Matrix

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



Savitribai Phule Pune University Fourth Year of Computer Engineering (2019 Course) 410246: Laboratory Practice III		
Teaching Scheme: Practical: 04 Hours/Week	Credit 02	Examination Scheme: Term work: 50 Marks Practical: 50 Marks
Companion Course: Design and Analysis of Algorithms (410241), Machine Learning(410242), Blockchain Technology(410243)		
Course Objectives: • Learn effect of data preprocessing on the performance of machine learning algorithms • Develop in depth understanding for implementation of the regression models. • Implement and evaluate supervised and unsupervised machine learning algorithms. • Analyze performance of an algorithm. • Learn how to implement algorithms that follow algorithm design strategies namely divide and conquer, greedy, dynamic programming, backtracking, branch and bound. • Understand and explore the working of Blockchain technology and its applications.		
Course Outcomes: After completion of the course, students will be able to CO1: Apply preprocessing techniques on datasets. CO2: Implement and evaluate linear regression and random forest regression models. CO3: Apply and evaluate classification and clustering techniques. CO4: Analyze performance of an algorithm. CO5: Implement an algorithm that follows one of the following algorithm design strategies: divide and conquer, greedy, dynamic programming, backtracking, branch and bound. CO6: Interpret the basic concepts in Blockchain technology and its applications		
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), curriculum of the course, conduction and 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 students in the form of a journal. Journal consists of Certificate, table of contents, and handwritten write-up of each assignment (Title, Date of Completion, Objectives, Problem Statement, Software and 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 a 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 a journal must be avoided. Use of DVD containing student 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 /Term Work Assessment

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

Guidelines for Practical Examination

Problem statements must be decided jointly by the internal examiner and 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. 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.

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

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

Programming tools recommended: - C++, Java, Python, Solidity, etc.

Virtual Laboratory:

- <http://cse01-iiith.vlabs.ac.in/>
- <http://vlabs.iitb.ac.in/vlabs-dev/labs/blockchain/labs/index.php>
- http://vlabs.iitb.ac.in/vlabs-dev/labs/machine_learning/labs/index.php

Suggested List of Laboratory Experiments/Assignments. Assignments from all the Groups (A, B, C) are compulsory.

Course Contents

Group A: Design and Analysis of Algorithms

Any 4 assignments and 1 mini project are mandatory.

1.	Write a program to calculate Fibonacci numbers and find its step count.
2.	Implement job sequencing with deadlines using a greedy method.
3.	Write a program to solve a fractional Knapsack problem using a greedy method.
4.	Write a program to solve a 0-1 Knapsack problem using dynamic programming or branch and bound strategy.
5.	Write a program to generate binomial coefficients using dynamic programming.
6.	Design 8-Queens matrix having first Queen placed. Use backtracking to place remaining Queens to generate the final 8-queen's matrix.

7.	Mini Project Write a program to implement matrix multiplication. Also implement multithreaded matrix multiplication with either one thread per row or one thread per cell. Analyze and compare their performance. OR Implement merge sort and multithreaded merge sort. Compare time required by both the algorithms. Also analyze the performance of each algorithm for the best case and the worst case. OR Implement the Naive string matching algorithm and Rabin-Karp algorithm for string matching. Observe difference in working of both the algorithms for the same input.
Group B: Machine Learning	
Any 4 assignments and 1 Mini project are mandatory.	
1.	Predict the price of the Uber ride from a given pickup point to the agreed drop-off location. Perform following tasks: 1. Pre-process the dataset. 2. Identify outliers. 3. Check the correlation. 4. Implement linear regression and random forest regression models. 5. Evaluate the models and compare their respective scores like R2, RMSE, etc. Dataset link: https://www.kaggle.com/datasets/yasserh/uber-fares-dataset
2.	Classify the email using the binary classification method. Email Spam detection has two states: a) Normal State – Not Spam, b) Abnormal State – Spam. Use K-Nearest Neighbors and Support Vector Machine for classification. Analyze their performance. Dataset link: The emails.csv dataset on the Kaggle https://www.kaggle.com/datasets/balaka18/email-spam-classification-dataset-csv
3.	Given a bank customer, build a neural network-based classifier that can determine whether they will leave or not in the next 6 months. Dataset Description: The case study is from an open-source dataset from Kaggle. The dataset contains 10,000 sample points with 14 distinct features such as CustomerId, CreditScore, Geography, Gender, Age, Tenure, Balance, etc. Link to the Kaggle project: https://www.kaggle.com/barelydedicated/bank-customer-churn-modeling Perform following steps: 1. Read the dataset. 2. Distinguish the feature and target set and divide the data set into training and test sets. 3. Normalize the train and test data. 4. Initialize and build the model. Identify the points of improvement and implement the same. 5. Print the accuracy score and confusion matrix (5 points).
4.	Implement Gradient Descent Algorithm to find the local minima of a function. For example, find the local minima of the function $y=(x+3)^2$ starting from the point $x=2$.
5.	Implement K-Nearest Neighbors algorithm on diabetes.csv dataset. Compute confusion matrix, accuracy, error rate, precision and recall on the given dataset. Dataset link : https://www.kaggle.com/datasets/abdallamahgoub/diabetes

6.	Implement K-Means clustering/ hierarchical clustering on sales_data_sample.csv dataset. Determine the number of clusters using the elbow method. Dataset link : https://www.kaggle.com/datasets/kyanyoga/sample-sales-data
7.	Mini Project Use the following dataset to analyze ups and downs in the market and predict future stock price returns based on Indian Market data from 2000 to 2020. Dataset Link: https://www.kaggle.com/datasets/sagara9595/stock-data OR Build a machine learning model that predicts the type of people who survived the Titanic shipwreck using passenger data (i.e. name, age, gender, socio-economic class, etc.). Dataset Link: https://www.kaggle.com/competitions/titanic/data

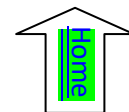
Group C: Blockchain Technology

Any 4 assignments and a Mini project are mandatory.

1.	Installation of Metamask and study spending Ether per transaction.
2.	Create your own wallet using Metamask for crypto transactions.
3.	Write a smart contract on a test network, for Bank account of a customer for following operations: • Deposit money • Withdraw Money • Show balance
4.	Write a program in solidity to create Student data. Use the following constructs: • Structures • Arrays • Fallback Deploy this as smart contract on Ethereum and Observe the transaction fee and Gas values.
5.	Write a survey report on types of Blockchains and its real time use cases.
6.	Mini Project: Create a dApp (de-centralized app) for e-voting system.

@The CO-PO Mapping Matrix

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



Savitribai Phule Pune University Fourth Year of Computer Engineering(2019Course) 410247:Laboratory Practice IV		
Teaching Scheme Practical:04 Hours/Week	Credit 01	Examination Scheme and Marks Term Work: 50 Marks
Companion Course: Elective III(410244), Elective IV(410245)		
Course Objectives: • Learn android application development related to pervasive computing • Understand various multimedia file formats • Understand various vulnerabilities and use of various tools for assessment of vulnerabilities • Understand information retrieval process using standard tools available • Learn GPU programming and implementation of same using open source libraries • Learn installation and use of open source software testing tools		
Course Outcomes: After completion of the course, students will be able to CO1: Apply android application development for solving real life problems CO2: Design and develop system using various multimedia components. CO3: Identify various vulnerabilities and demonstrate using various tools. CO4: Apply information retrieval tools for natural language processing CO5: Develop an application using open source GPU programming languages CO6: Apply software testing tools to perform automated testing		
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), curriculum of the course, conduction and 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 and 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/Term Work 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 and punctuality.		
Guidelines for Practical Examination Problem statements must be decided jointly by the internal examiner and 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. 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.

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.

Virtual Laboratory: 1. <https://hci-iitg.vlabs.ac.in/>
2. <http://vlabs.iitkgp.ernet.in/se/>
3. <https://vlab.amrita.edu/?sub=3&brch=179&sim=1293&cnt=2>

410244(A) Pervasive Computing

Any 5 assignments from group 1 and 1 Mini project from group 2 is mandatory.

Group 1

1. Develop an indoor location system to Library guide system where it can direct a user to the bookshelf from a mobile device.
2. Design a pervasive application in which remote computer monitors our health statistics & will determine when one is in trouble & will take appropriate action for rescue.
3. Develop an Android application in which car will use the Internet to find nearby open parking space.
4. Android User Activity Recognition – Still, Walking, Running, Driving etc.
5. Design and build a sensing system using micro-controllers like - Arduino / Raspberry Pi / Intel Galileo to sense the environment around them and act accordingly.
6. Smart Mobile Application with orientation sensing for users to put the phone in meeting / silent mode- OR- outdoor/ loud mode based on the orientation of the device.

Group 2.

7. **Mini project:** Develop Food Ordering System which uses the GPS of an Android-based Smartphone to record and analyze various locations that could give alert to the user, then asking the user to select particular food from given hotel list and place an order.
8. **Mini Project :** Design a mobile sensing platform mounted on a glove that integrates several sensors, such as touch pressure, imaging, inertial measurements, localization and a Radio Frequency Identification (RFID) reader for fruit classification and grading system.

9.	Mini Project : Sensor-Based Assistive Devices for Visually Impaired People. It should cover following points: ○ Determining obstacles around the user body from the ground to the head; ○ Affording some instructions to the user about the movement surface consists of gaps or textures; ○ Finding items surrounding the obstacles; ○ Providing information about the distance between the user and the obstacle with essential direction instructions.
10.	Mini Project: Develop a Real time application like a smart home with following requirements: If anyone comes at door the camera module automatically captures his image send it to the email account of user or send notification to the user. Door will open only after user's approval.

410244(B) Multimedia Techniques

Group 1

Any 5 assignments from group 1 and 1 Mini project from group 2 is mandatory.

1.	To study and install open-source multimedia tools and create an application using appropriate tool to design the college webpage
2.	To create JPEG Image that demonstrate various features of an Image editing tool.
3.	Create or play a sample MIDI format sound file using LMMS / MuseScore / Tuxguitar software tool. Edit the sample file by applying effects like bend, slide, vibrato, and hammer-on/pull-off. Export / Convert final MIDI to WAV file format.
4.	Implement transform coding, quantization, and hierarchical coding for the encoder and decoder of three-level Hierarchical JPEG.
5.	Create an immersive environment (living room/ battlefield/ tennis court) with only static game objects. 3D game objects can be created using Blender or use available 3D models.
6.	Create a web page for a clothing company which contains all the details of that company and atleast five links to other web pages.

Group2

7.	Mini Project: Design and develop a Navigation Assistance System.
8.	Mini Project: Design and Develop a Traffic Monitoring System.

410244(C) Cyber Security and Digital Forensics

Any 5 assignments from group 1 and 1 Mini project from group 2 is mandatory.

Group 1

1.	Write a program for Tracking Emails & Investigating Email Crimes. i.e. Write a program to analyze e-mail header
2.	Implement a program to generate & verify CAPTCHA image
3.	A person on a nearby road is trying to enter into a WiFi network by trying to crack the Password to use the IP Printer resource; write a program detect such attempt and prohibit the

	access. Develop the necessary scenario by Using an IEEE 802.11, configure a Wi-Fi adapter and Access Point
4.	Write a computer forensic application program for Recovering permanent Deleted Files and Deleted Partitions
5.	Write a program for Log Capturing and Event Correlation
6.	Configure and demonstrate use of vulnerability assessment tool like Wireshark or SNORT
7.	Study of Honeypot

Group 2

1.	Mini-project: Perform the following steps: - Go to the National Child Exploitation Coordination Centre (NCECC) Web site at http://www.ncecc.ca - Click on the Reporting child exploitation link. c. Read “How to Report Internet Pornography or Internet Luring Related to Children.”
2.	Mini- Project: Perform the following steps: - Go to http://www.usdoj.gov/criminal/cybercrime/cyberstalking.htm. b. Read the 1999 report on cyber stalking.

410244(D) Object Oriented Modeling and Design

Any 5 assignments from group 1 and 1 Mini project from group 2 is mandatory.

Group 1

1.	Draw state model for telephone line, with various activities.
2.	Draw basic class diagrams to identify and describe key concepts like classes, types in your system and their relationships.
3.	Draw one or more Use Case diagrams for capturing and representing requirements of the system. Use case diagrams must include template showing description and steps of the Use Case for various scenarios.
4.	Draw one or more Use Case diagrams for capturing and representing requirements of the system. Use case diagrams must include template showing description and steps of the Use Case for various scenarios.
5.	Draw activity diagrams to display either business flows or like flow charts
6.	Draw component diagrams assuming that you will build your system reusing existing components along with a few new ones
7.	Draw deployment diagrams to model the runtime architecture of your system.

Group 1

8.	Mini Project: Draw all UML diagrams for your project work.
9.	Mini Project: Draw following UML Diagrams for Bank Management application a. Class Diagram b. Object Diagram c. ER Diagram d. Component Diagram

410244(E) Digital Signal Processing

Any 5 assignments from group 1 and 1 Mini project from group 2 is mandatory

Group 1:

1.	Develop a program to generate samples of sine, Cosine and exponential signals at specified sampling frequency and signal parameters. (Test the results for different analog frequency (F) and sampling frequency (Fs)). 23. 4. 5. 6. 7.
2.	Find the output of a system described by given difference equation and initial conditions for given input sequence. (Solution of difference equation) (Obtain the response for different systems by changing Degree of difference equation (N) and coefficients and also for different input sequence $x(n)$. Observe the response by considering system as FIR and IIR system).
3.	Write a program to plot the magnitude and phase response of a Fourier Transform (FT). (Observe the spectrum for different inputs. Observe the Periodicity).
4.	Find the N point DFT / IDFT of the given sequence $x(n)$. Plot the magnitude spectrum $ X(K) $ Vs K. (Analyze the output for different N and the same input sequence $x(n)$. Also observe the periodicity and symmetry property).
5.	Find the N point circular convolution of given two sequences. Test it for Linear convolution. Compute the circular convolution of given two sequences using DFT and IDFT.
6.	Develop a program to plot the magnitude and phase response of a given system (given: $h(n)$: impulse response of system S) (Observe the frequency response for different systems. Compare the frequency response of a system (filter) for different length $h(n)$ i.e filter coefficients).

Group 2:

7.	Mini-Project: Design and Develop the N-point radix-2 DIT or DIF FFT algorithm to find DFT or IDFT of given sequence $x(n)$. (Analyze the output for different N. Program should work for any value of N and output should be generated for all intermediate stages.) 8 9.
8.	Mini-Project: Obtain the Fourier transform of different window functions to plot the magnitude and phase spectrums. (Window functions: Rectangular, Triangular, Bartlett, Hamming, Henning, Kaiser. Observe and compare the desirable features of window sequences for different length. Observe the main and side lobes).
9.	Mini-Project: Design an FIR filter from given specifications using windowing method. (Application should work for different types of filter specifications i.e. LPF, HPF, BPF etc and all window sequences. Plot the frequency response for different frequency terms i.e. analog and DT frequency). 10.
10	Mini-Project: Design of IIR filter for given specifications using Bilinear Transformation. (Generalized code to accept any filter length for a transfer function $H(Z)$. Application should work for different types of filter specifications that is LPF, HPF, BPF etc. and for different transfer functions of an analog filter).

410245(A) Information Retrieval

Any 5 assignments from group 1 and 1 Mini project from group 2 is mandatory

Group 1:

1.	Write a program to Compute Similarity between two text documents.
2.	Implement Page Rank Algorithm.
3.	Write a program for Pre-processing of a Text Document: stop word removal.
4.	Write a map-reduce program to count the number of occurrences of each alphabetic character in the given dataset. The count for each letter should be case-insensitive (i.e., include both upper-case and lower-case versions of the letter; Ignore non-alphabetic characters).
5.	Write a program to implement simple web crawler.
6.	Write a program to parse XML text, generate Web graph and compute topic specific page

Group 2:

7.	Mini project: Develop Document summarization system
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8.	Mini Project: Develop Tweet sentiment analysis system
9.	Mini Project: Develop Fake news detection system
410245(B) GPU Programming and Architecture	
Any 5 assignments from group 1 and 1 Mini project from group 2 is mandatory	
Group 1:	
1.	Write program using OpenCL for Heterogeneous computing
2.	Write CUDA programming with some simple things such as dot product, calculation of pi using integration method etc.
3.	Write CUDA programming for matrix transpose and matrix multiplication
4.	Write OpenCL “Hello World” basic program
5.	Develop program using combining abilities of OpenGL and CUDA to accelerate the performance of simple graphics.
6.	Case study on “Review of traditional Computer Architecture
Group 2:	
	Mini Project : huge data computation
	Mini Project : Visualization to develop project for image processing and then video processing
	Mini Project : Parallel programming
410245(C) Mobile Computing	
Any 5 assignments from group 1 and 1 Mini project from group 2 is mandatory	
Group 1:	
1.	To implement a basic function of Code Division Multiple Access (CDMA) to test the orthogonally and autocorrelation of a code to be used for CDMA operation. Write an application based on the above concept.
2.	Implementation of GSM security algorithms (A3/A5/A8)
3.	Write an application that draws basic graphical primitives on the screen.
4.	Develop a native application that uses GPS location information.
5.	Design an android Application for Frame Animation
Group 2:	
6.	Mini Project: Create an application for Bank using spinner, intent a) Form 1: Create a new account for customer b) Form 2: Deposit money in customer account. c) Link both forms, after completing of first form the user should be directed to the second form

	d) Provide different menu options
7.	Mini Project: Create the module for collecting cellular mobile network performance parameters using telephony API Manager i) Nearest Base Station ii) Signal Strengths iii) SIM Module Details iv) Mobility Management Information
8.	Mini Project: Create the module for payment of fees for College by demonstrating the following methods. i) FeesMethod()- for calculation of fees ii) Use customized Toast for successful payment of fees iii) Implement an alarm in case someone misses out on the fee submission deadline iv) Demonstrate the online payment gateway
9.	Mini Project: Create an app to add of a product to SQLite database and make sure to add following features i) SMS messaging and email provision ii) Bluetooth options iii) Accessing Web services iv) Asynchronous remote method call v) Use Alert box for user notification

410245(D)Software Testing and Quality Assurance

Any 5 assignments from group 1 and 1 Mini project from group 2 is mandatory

Group 1:

1.	Write TEST Scenario for Gmail Login Page
2.	TEST Scenario for Gmail Login Page
3.	Write Test cases in excel sheet for Social Media application or website
4.	Create Defect Report for Any application or web application
5.	Installation of Selenium grid and selenium Webdriver & java eclipse (automation tools).
6.	Prepare Software requirement specification for any project or problem statement

Group 2:

7.	Mini Project : Software Testing and Quality Assurance Mini Project Dynamic website of covid-19 information using HTML, CSS, JAVASCRIPT And PHP, MySQL database used to store user account, comment, and registration form details. Regular Expression testcases for testing purpose
8.	Mini Project : Create a small application by selecting relevant system environment / platform and programming languages. Narrate concise Test Plan consisting features to be tested and bug taxonomy. Prepare Test Cases inclusive of Test Procedures for identified Test Scenarios. Perform selective Black-box and White-box testing covering Unit and Integration test by using

	suitable Testing tools. Prepare Test Reports based on Test Pass/Fail Criteria and judge the acceptance of application developed											
9.	Mini Project : Create a small web-based application by selecting relevant system environment / platform and programming languages. Narrate concise Test Plan consisting features to be tested and bug taxonomy. Narrate scripts in order to perform regression tests. Identify the bugs using Selenium WebDriver and IDE and generate test reports encompassing exploratory testing.											
410245(E) Quantum Computing												
1.	Analyze simple states of superposition and the effect of doing the measurement in different basis states .											
2.	Build simple quantum circuits with single and two-qubit gates											
3.	Install Setup for running quantum programs on IBM machines.											
4.	Analyze the effectiveness of simple error correction scheme											
5.	Implement quantum programs in NISQ model of computing											
<u>@TheCO-POMappingMatrix</u>												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	2	-	3	-	-	2	2	2	1	2
CO2	1	-	2	2	3	2	-	2	2	2	1	2
CO3	1	-	2	2	3	2	-	2	2	2	2	2
CO4	1	-	2	-	3	-	-	2	2	2	2	2
CO5	1	-	2	-	3	-	-	2	2	2	2	2
CO6	1	-	2	-	3	-	-	2	2	2	2	2



SavitribaiPhulePuneUniversity Fourth Year of Computer Engineering (2019 Course) 410248: Project Work Stage I		
TeachingScheme:	Credit	ExaminationScheme:
Practical:02Hours/Week	02	Presentation:50Marks

CourseObjectives:

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

Course Outcomes:

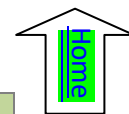
On completion of the course, student will be able to–

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

Guidelines

Project work Stage – I is an integral part of the Project work. In this, the student shall complete the partial work of the Project which will consist of problem statement, literature review, SRS, Model and Design. The student is expected to complete the project at least up to the design phase. As a part of the progress report of project work Stage-I, the candidate shall deliver a presentation on the advancement in Technology pertaining to the selected project topic. The student shall submit the duly certified progress report of Project work Stage-I in standard format for satisfactory completion of the work by the concerned guide and head of the Department/Institute. The examinee will be assessed by a panel of examiners of which one is necessarily an external examiner. The assessment will be broadly based on work undergone, content delivery, presentation skills, documentation, question-answers and report.

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



Savitribai Phule Pune University
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In addition to credits, it is recommended that there should be audit course, in preferably in each semester starting from second year in order to supplement students' knowledge and skills. Student will be awarded the bachelor's degree if he/she earns specified total credit [\[1\]](#) and clears all the audit courses specified in the curriculum. 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 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 [\[1\]](#)

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

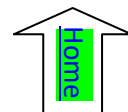
- | | |
|--|---|
| <ul style="list-style-type: none"> Lectures/ Guest Lectures Visits (Social/Field) and reports Demonstrations or presentations | <ul style="list-style-type: none"> Surveys Mini-Project Hands on experience on focused topic |
|--|---|

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

- Written Test
- Demonstrations/ Practical Test
- Presentation or Report

Audit Course 5 Options

Audit Course Code	Audit Course Title
AC7-I	MOOC- Learn New Skills
AC7-II	Entrepreneurship Development
AC7-III	Botnet of Things
AC7-IV	3D Printing
AC7-V	Industrial Safety and Environment Consciousness



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AC7 – I: MOOC-learn New Skill

This course aims to create awareness among the students regarding various courses available under MOOC and learn new skills through these courses.

Course Objectives:

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

Course Outcomes:

On completion of the course, , students will be able to

CO1: To acquire additional knowledge and skill.

About Course

MOOCs (Massive Open Online Courses) provide affordable and flexible way to learn new skills, pursue lifelong interests and deliver quality educational experiences at scale. Whether you're interested in learning for yourself, advancing your career or leveraging online courses to educate your workforce, SWAYAM, NPTEL, edx or similar ones can help. World's largest SWAYAM MOOCs, a new paradigm of education for anyone, anywhere, anytime, as per your convenience, aimed to provide digital education free of cost and to facilitate hosting of all the interactive courses prepared by the best more than 1000 specially chosen faculty and teachers in the country. SWAYAM MOOCs enhances active learning for improving lifelong learning skills by providing easy access to global resources.

SWAYAM is a programme initiated by Government of India and designed to achieve the three cardinal principles of Education Policy viz., access, equity and quality. The objective of this effort is to take the best teaching learning resources to all, including the most disadvantaged. SWAYAM seeks to bridge the digital divide for students who have hitherto remained untouched by the digital revolution and have not been able to join the mainstream of the knowledge economy. This is done through an indigenous developed IT platform that facilitates hosting of all the courses, taught in classrooms from 9th class till post-graduation to be accessed by anyone, anywhere at any time. All the courses are interactive, prepared by the best teachers in the country and are available, free of cost to the residents in India. More than 1,000 specially chosen faculty and teachers from across the Country have participated in preparing these courses.

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

Guidelines:

Instructors are requested to promote students to opt for courses (not opted earlier) with proper mentoring. The departments will take care of providing necessary infrastructural and facilities for the learners.

References:

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

Savitribai Phule Pune University, Pune
Fourth Year of Computer Engineering (2019 Course)
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AC7 – II: Entrepreneurship Development

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

Course Objectives:

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

Course Outcomes:

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

- CO1: Understand the legalities in product development
- CO2: Undertake the process of IPR, Trademarks, Copyright and patenting
- CO3: Understand and apply functional plans
- CO4: Manage Entrepreneurial Finance
- CO5: Inculcate managerial skill as an entrepreneur

Course Contents

1. Introduction: Concept and Definitions, Entrepreneur v/s Intrapreneur; Role of entrepreneurship in economic development; Entrepreneurship process; Factors impacting emergence of entrepreneurship; Managerial versus entrepreneurial Decision Making; Entrepreneur v/s Investors; Entrepreneurial attributes and characteristics; Entrepreneurs versus inventors; Entrepreneurial Culture; Women Entrepreneurs; Social Entrepreneurship; Classification and Types of Entrepreneurs; EDP Programmers; Entrepreneurial Training; Traits/Qualities of an Entrepreneurs.

2. Creating Entrepreneurial Venture : Generating Business idea- Sources of Innovation, methods of generating ideas, Creativity and Entrepreneurship; Business planning process; Drawing business plan; Business plan failures; Entrepreneurial leadership – components of entrepreneurial leadership; Entrepreneurial Challenges; Legal issues – forming business entity, considerations and Criteria, requirements for formation of a Private/Public Limited Company, Intellectual Property Protection - Patents Trademarks and Copyrights.

3. Functional plans: Marketing plan–for the new venture, environmental analysis, steps in preparing marketing plan, marketing mix, contingency planning; Organizational plan – designing organization structure and Systems; Financial plan – pro forma income statements, Ratio Analysis.

4. Entrepreneurial Finance: Debt or equity financing, Sources of Finance - Commercial banks, private placements, venture capital, financial institutions supporting entrepreneurs; Lease Financing; Funding opportunities for Startups in India. 5. Enterprise Management: Managing growth and sustenance- growth norms; Factors for growth; Time management, Negotiations, Joint ventures, Mergers and acquisition

Books:

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

Savitribai Phule Pune University, Pune
Fourth Year of Computer Engineering (2019 Course)
410249: Audit Course 7
AC7 – III: Botnet of Things

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

Course Objectives:

- To Understand the various IoT Protocols
- To Understand the IoT Reference Architecture and Real World Design Constraints
- To learn the concept of Botnet

Course Outcomes:

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

CO1: Implement security as a culture and show mistakes that make applications vulnerable to attacks.

CO2: Understand various attacks like DoS, buffer overflow, web specific, database specific, web -spoofing attacks.

CO3: Demonstrate skills needed to deal with common programming errors that lead to most security problems and to learn how to develop secure applications

Course Contents

1. Introduction

2. IRC-Based Bot Networks

3. Anatomy of a Botnet: The Gaobot Worm

4. IoT Sensors and Security : Sensors and actuators in IoT, Communication and networking in IoT, Real-time data collection in IoT, Data analytics in IoT , IoT applications and requirements, Security threats and techniques in IoT, Data trustworthiness and privacy in IoT, Balancing utility and other design goals in IoT , Future of Botnets in the Internet of Things, Thingbots, Elements of Typical IRC Bot Attack , Malicious use of Bots and Botnet

5. Service Layer Protocols and Security : Security: PHP Exploits, Cross-Site Scripting and Other Browser-Side Exploits, Bots and Botnets, Service Layer -oneM2M, ETSI M2M, OMA, BBF – Security in IoT Protocols –MAC 802.15.4 , 6LoWPAN, RPL, Application Layer Transport and Session layer protocols-transport Layer (TCP, MPTCP, UDP, DCCP, SCTP) - (TLS, DTLS) –

Session Layer - HTTP, CoAP, XMPP, AMQP, MQTT

Books:

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

Savitribai Phule Pune University
Fourth Year of Engineering (2019 Course)
410249: Audit Course 7
AC7 – IV: 3D Printing

This course aims to provide knowledge of 3D printing devices and explore the business side of 3D printing.

Course Objectives:

- To **acquire** basic knowledge of drafting terminology and construction of geometrical figures using drawing instruments, procedure to prepare a drawing sheet as per SP-46:2003
- To **inculcate** skill of technical sketching, multi-view drawings, Lettering, tolerance, and metric construction
- To **impart** practical aspects to generate detailed and assembly views with dimensions, annotations, in 3D Modeling software.
- To **develop** prototype/ end use product for 3D Printing

Course Outcomes:

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

CO1: Understand the basic knowledge of Shop Floor Safety rules and regulations basics of Machinetools and 3D printing machines

CO2: Understand the concept of concept of technical sketching, multi-view drawings, Lettering, tolerance, and metric construction

CO3: Identify and Distinguish drafting terminologies and construction of geometrical figures using drawing instruments, procedure to prepare a drawing sheet as per SP-46:2003

CO4: Describe and Explain practical aspects to generate detailed and assembly views with dimensions, annotations, in 3D Modeling software.

CO5: Apply concepts and **Fabricate** the simple mechanical parts, prototype/ end use product for 3D Printing

Course Contents

1. Getting Started with 3D Printing: How 3D Printers Fit into Modern Manufacturing, Exploring the Types of 3D Printing, Exploring Applications of 3D Printing.

2. Outlining 3D Printing Resources: Identifying Available Materials for 3D Printing, Identifying Available Sources for 3D Printable Objects.

3. Exploring the Business Side of 3D Printing: Commoditizing 3D Printing, Understanding 3D Printing's Effect on Traditional lines of Business, Reviewing 3D Printing Research.

4. Employing Personal 3D printing Devices: Exploring 3D printed Artwork, Considering Consumer level 3D Printers, Deciding on RepEap of Your Own.

Books:

1. Richard Horne, Kalani Kirk Hausman, “3D Printing for Dummies”, Taschenbuch, ISBN: 9781119386315

2. Greg Norton, “3D Printing Business - 3D Printing for Beginners - How to 3D Print”, ISBN: 9781514785669

2. Liza Wallach Kloski and Nick Kloski, “Getting Started with 3D Printing: A Hands-on Guide to the Hardware, Software, and Services Behind the New Manufacturing Revolution”, Maker Media, ISBN: 1680450204

4. Jeff Heldrich, “3D Printing: Tips on Getting Started with 3D Printing to Help you make Passive income for your Business”

Savitribai Phule Pune University, Pune
Fourth Year of Computer Engineering (2019 Course)
410249: Audit Course 7
AC7 – V: Industrial Safety and Environment Consciousness

This course aims to provide knowledge of industrial safety performance planning and accident prevention.

Course Objectives:

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

Course Outcomes:

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

- CO1: Develop the plan for Safety performance
 CO2: Demonstrate the action plan for accidents and hazards
 CO3: Apply the safety and security norms in the industry
 CO4: Evaluate the environmental issues of Industrialization

Course Contents

1. Introduction: Elements of safety programming, safety management, Upgrading developmental programmers: safety procedures and performance measures, education, training and development in safety.

2. Safety Performance Planning

Safety Performance: An overview of an accident, It is an accident, injury or incident, The safety professional, Occupational health and industrial hygiene. Understanding the risk: Emergency preparedness and response, prevention of accidents involving hazardous substances.

3. Accident Prevention

What is accident prevention?, Maintenance and Inspection, Monitoring Techniques, General Accident Prevention, Safety Education and Training.

4. Organization Safety

Basic Elements of Organized Safety, Duties of Safety Officer, Safe work Practices, Safety Sampling and Inspection, Job Safety Analysis(JSA), Safety Survey, On- site and Off-site Emergency Plan, Reporting of Accidents and Dangerous Occurrences.

5. Industrial Pollution

Introduction, Work Environment, Remedy, pollution of Marine Environment and Prevention, Basic Environmental Protection Procedures, Protection of Environment in Global Scenario, Greenhouse Gases, Climate Change Impacts, GHG Mitigation Options, Sinks and Barriers,

6. Industrial Security(Industry wise)

General security Systems in Factories, Activation Security, Computer Security, Banking Security, V.I.P. Security, Women Security, Event Security, Security in Open Environments.

Books :

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