SYLLABI OF ALL ELECTIVE SUBJECTS ELECTED BY STUDENTS IS GIVEN IN THIS DOCUMENT FOR B.E. COMPUTER ENGINEERING AND T.E. COMPUTER ENGINEERING

Total elective subjects offered = 06 Third Year 02 Electives, Final Year 04 Electives

Curriculum
for

Third Year of Computer Engineering
(2019 Course)

(With effect from 2021-22)

http://unipune.ac.in

Faculty of Science and Technology

Savitribai Phule Pune University
Maharashtra, India

Savitribai Phule Pune University

Third Year of Computer Engineering (2019 Course)

(With effect from Academic Year 2021-22)

Home

Semester V

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	Total	Lecture	Practical	Tutorial	Total
310241	Database Management Systems	03	-	-	30	70	-	-	-	100	03	-	-	03
310242	Theory of Computation	03	-	-	30	70	-	-	-	100	03	-	-	03
310243	Systems Programming and Operating System	03	-	-	30	70	-	-	-	100	03	-	-	03
310244	Computer Networks and Security	03	-	-	30	70	-	-	-	100	03	-	-	03
310245	Elective I	03	-	-	30	70	-	-	-	100	03	-	-	03
310246	Database Management Systems Laboratory	-	04	-	-	-	25	25	-	50	-	02	-	02
310247	Computer Networks and Security Laboratory	-	02	-	-	-	25	-	25	50	-	01	-	01
310248	Laboratory Practice I	-	04	-	-	-	25	25	-	50	-	02	-	02
310249	Seminar and Technical Communication	-	-	01	-	-	50	-	-	50	-	-	01	01
	Total	**15**	**10**	**01**	**150**	**350**	**125**	**50**	**25**	**700**	**15**	**05**	**01**	**21**
310250	Audit Course 5												**Grade**	
										Total Credit	**15**	**05**	**01**	**21**

310245 **Elective I Options:**

310245(A) Internet of Things and Embedded Systems
310245(B) Human Computer Interface
310245(C) Distributed Systems
310245(D) Software Project Management

310250 Audit Course 5 Options:

310250 (A) Cyber Security
310250 (B) Professional Ethics and Etiquettes
310250 (C) Learn New Skills
310250 (D) Engineering Economics
310250 (E) Foreign Language

Laboratory Practice I

Assignments from **Systems Programming and Operating System** and **Elective I**

Savitribai Phule Pune University

Third Year of Computer Engineering (2019 Course)

(With effect from Academic Year 2021-22)

Home

Semester VI

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	Total	Lecture	Practical	Tutorial	Total
310251	Data Science and Big Data Analytics	04	-	-	30	70	-	-	-	100	03	-	-	03
310252	Web Technology	04	-	-	30	70	-	-	-	100	03	-	-	03
310253	Artificial Intelligence	04	-	-	30	70	-	-	-	100	03	-	-	03
310254	Elective II	04	-	-	30	70	-	-	-	100	03	-	-	03
310255	Internship**	-	-	-	-	-	100 **	-	-	100	-	-	-	04 **
310256	Data Science and Big Data Analytics Laboratory	-	04	-	-	-	50	25	-	75	-	02	-	02
310257	Web Technology Laboratory	-	02	-	-	-	25	-	25	50	-	01	-	01
310258	Laboratory Practice II	-	04	-	-	-	50	25	-	75	-	02	-	02
	Total	**12**	**10**	**-**	**120**	**280**	**225**	**50**	**25**	**700**	**12**	**09**	**-**	**21**
310259	Audit Course 6												**Grade**	
										Total	**12**	**09**	**-**	**21**

310254 Elective II Options:

310254(A) Information Security
310254(B) Augmented and Virtual Reality
310254(C) Cloud Computing
310254(D) Software Modeling and Architectures

310259 Audit Course 6 Options:

310259(A) Digital and Social Media Marketing
310259(B) Sustainable Energy Systems
310259(C) Leadership and Personality Development
310259(D) Foreign Language
310259(E) Learn New Skills

Laboratory Practice II:

Assignments from **Artificial Intelligence** and **Elective II**.

**** Internship:**

Internship guidelines are provided in course curriculum sheet.

$$ Hours/Week for Theory Course in Third Year of Engineering, Semester VI:

As per the apex bodies' recommendations and guidelines, it is need of the day to train the pre-final year students for the industrial readiness through internship. As per the guidelines of AICTE, the duration of internship is 4-6 weeks after completion of semester V and before commencement of semester VI, so it is apparent that the contact hours of the TE students need to be managed meticulously. It becomes mandatory as per the structure that 4 credits for internship must earned by the students. **Per semester, 15 weeks duration that is suggested ideally by the affiliated university will eventually reduce to fruitful 12 weeks after the implementation of the revised curriculum (2019 Course). With the evaluatory introduction of internship in the structure, we are left with the choice of 4 theory courses in the sixth semester with 12 weeks instead of traditional 15 weeks.** To balance the credits and to achieve the minimum required contact hours, it is the reasonable choice to allot 4 hours / week for each theory course of the sixth semester of Third year of Engineering. The additional one lecture/ week will definitely be instrumental in achieving the largest of minimum contact hours. As such there is no correspondence of weekly load and credits earned, the credit allotted per course remain intact despite of the change. **So it is almost imperative that the commencement of VI Semester need to be approx. 3 weeks beyond the schedule.**

Savitribai Phule Pune University
Third Year of Computer Engineering (2019 Course)
Elective I
310245(D): Software Project Management

Home

Teaching Scheme:	Credit: 03	Examination Scheme:
Theory: 03 Hours/Week		Mid-Sem (TH) : 30 Marks End-Sem (paper): 70 Marks

Prerequisites Courses: Software Engineering(210253)

Companion Course: Laboratory Practice I (310248)

Course Objectives:

- To understand the fundamentals of Software Project Management
- To investigate software project planning and management tools
- To learn software project scheduling and tracking
- To discuss about the agile project management
- To know people management in software project

Course Outcomes:

On completion of the course, learners should be able to

- **CO1:** Comprehend Project Management Concepts
- **CO2:** Use various tools of Software Project Management
- **CO3:** Schedule various activities in software projects
- **CO4:** Track a project and manage changes
- **CO5:** Apply Agile Project Management
- **CO6:** Analyse staffing process for team building and decision making in Software Projects and Management

Course Contents

Unit I	Introduction to Software Project Management	07 Hours

Project Definition, Project versus Flow type work, Project Lifecycle, Processes and Knowledge Areas in Project Management (PM), Build or Buy decision, Work Breakdown Structure (WBS) and its types, Introduction to PMBOK, Program and Portfolio Management.

#Exemplar/Case Studies	Analysis of a project using PMBOK concepts
***Mapping of Course Outcomes for Unit I**	CO1

Unit II	Project Planning and Project Management Tools	07 Hours

Project Planning: Steps for Project Planning, PERT and Gantt Charts, Gantt Project, Microsoft Project and Primavera Project Management Software, Objectives of Activity planning, Project Schedules, Activities, Sequencing and Scheduling, Network Planning Models, Formulating Network Model.

#Exemplar/Case Studies	Create software project plan using any tool.
***Mapping of Course Outcomes for Unit II**	CO2

Unit III	Activity based Scheduling	07 Hours

Introduction, Objectives of Activity Planning, Project Schedules. **Activities**: Sequencing and Scheduling, Network Planning Models, Formulating Network Model, Activity relationships (FS,SF,SS,FF), Forward Pass and Backward Pass techniques, Critical Path concept and remedies.

#Exemplar/Case Studies	Apply the critical path technique to the project
***Mapping of Course Outcomes for Unit III**	CO3

Unit IV	Project Tracking and Control	07 Hours

Introduction, Collection of Project data, Visualizing progress, Cost monitoring, Earned Value Analysis, Project tracking, Change Control, Software Configuration Management, Managing contracts, Contract Management.	
#Exemplar/Case Studies	Analyze the effect of a major requirement change on the schedule
***Mapping of Course Outcomes for Unit IV**	CO4

Unit V	**Agile Project Management**	**07 Hours**
Predictive versus Empirical Management, Comparison between Non-Agile and Agile Project, Three stages of Agile Project, Estimation, Scope Management, Roles and Responsibilities, Scheduling and Tracking.		
#Exemplar/Case Studies	Analyse the same project using Agile. Create the three stages of the project.	
***Mapping of Course Outcomes for Unit V**	CO5	

Unit VI	**Staffing in Software Projects**	**07 Hours**
Managing People, Organizational behaviour, Best methods of Staff Selection, Motivation, The Oldham, Hackman job characteristic Model, Stress, Health and Safety, Ethical and Professional concerns, Working in Teams, Decision Making, Organizational structures, Dispersed and Virtual Teams, Communications Genres, Communication Plans.		
#Exemplar/Case Studies	Analyse a case study for a distributed team and comment	
***Mapping of Course Outcomes for Unit VI**	CO6	

Learning Resources

Text Books:

1. Bob Hughes, Mike Cotterell and Rajib Mall, "Software Project Management", Sixth Edition, Tata McGraw Hill, New Delhi, 2017
2. Robert K. Wysocki, "Effective Software Project Management", Wiley Publication, 2011

Reference Books :

1. Ken Schwaber, "Agile Project Management", Microsoft Press, 2004
2. Walker Royce, "Software Project Management", Addison-Wesley, 1998
3. Jalote Pankaj, "Software Project Management in Practice", Addison-Wesley Professional,2002
4. PMBOK Guide

e-Books :

- https://www.kornev-online.net/ITIL/Mcgraw.Hill.Software_Project_Management_2nd_Edition.pdf
- http://library.lol/main/B96E3B122326F8D2C6FBD35A5E978422

MOOCs Courses Links:

- https://onlinecourses.nptel.ac.in/noc19_cs70/preview
- Software Project Management By Prof. Rajib Mall & Prof. Durga Prasad Mohapatra | IIT Kharagpur
- Agilealliance.org, Scrum.org, Scrumalliance.org

@ The CO-PO Mapping Matrix

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

Savitribai Phule Pune University
Third Year of Computer Engineering (2019 Course)
310248: Laboratory Practice I

Home

Teaching Scheme	Credit:02	Examination Scheme and Marks
Practical: 04 Hours/Week		Term work: 25 Marks Practical: 25 Marks

Companion Course: Systems Programming and Operating System (310243), Elective I(310245)

Course Objectives:

- To learn system programming tools
- To learn modern operating system
- To learn various techniques, tools, applications in IoT and Embedded Systems /Human Computer Interface/Distributed Systems/ Software Project Management

Course Outcomes:

On completion of the course, learners will be able to

- **Systems Programming and Operating System**
  - **CO1:** Implement language translators
  - **CO2**: Use tools like LEX and YACC
  - **CO3**: Implement internals and functionalities of Operating System
- **Internet of Things and Embedded Systems**
  - **CO4:** Design IoT and Embedded Systems based application
  - **CO5:** Develop smart applications using IoT
  - **CO6:** Develop IoT applications based on cloud environment

OR

- **Human Computer Interface**
  - **CO4:**Implement the interactive designs for feasible data search and retrieval
  - **CO5:**Analyze the scope of HCI in various paradigms like ubiquitous computing, virtual Reality and ,multi-media, World wide web related environments
  - **CO6:**Analyze and identify user models, user support, socio-organizational issues, and stakeholder requirements of HCI systems

OR

- **Distributed Systems**
  - **CO4:** Demonstrate knowledge of the core concepts and techniques in Distributed Systems
  - **CO5**: Apply the principles of state-of-the-Art Distributed Systems in real time applications
  - **CO6**: Design, build and test application programs on Distributed Systems

OR

- **Software Project Management**
  - **CO4:**Apply Software Project Management tools
  - **CO5:**Implement software project planning and scheduling
  - **CO6:**Analyse staffing in software project

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, punctuality and

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. For the elective subjects students should form group of 3-4 students. The faculty coordinator will take care that all the assignment should be assigned to class and minimum two assignments are compulsory for each group.

Programming tools recommended: -

Human computer Interface-GUI in python

Internet of Things and Embedded System- Raspberry Pi/Arduino Programming; Arduino IDE/Python Interfacing. Other IoT devices

Software project management-MS project/Gantt Project/Primavera

Virtual Laboratory:

- http://cse18- iiith.vlabs.ac.in/Introduction.html?domain=Computer%20Scie nce
- http://vlabs.iitb.ac.in/vlabs-dev/labs/cglab/index.php

Suggested List of Laboratory Experiments/Assignments

Assignments from all Groups (A, B, C) are compulsory

Part I: Systems Programming and Operating System

Sr. No.	Group A (Any Two Assignments from Sr. No. 1 to 3)
1.	Design suitable Data structures and implement Pass-I and Pass-II of a two-pass assembler for pseudo-machine. Implementation should consist of a few instructions from each category and few assembler directives. The output of Pass-I (intermediate code file and symbol table) should be input for Pass-II.

2.	Design suitable data structures and implement Pass-I and Pass-II of a two-pass macro-processor. The output of Pass-I (MNT, MDT and intermediate code file without any macro definitions) should be input for Pass-II.
3.	Write a program to create a Dynamic Link Library for any mathematical operation and writean application program to test it. (Java Native Interface / Use VB or VC++)
	Group B(Any Two Assignments from Sr. No. 4 to 7)
4.	Write a program to solve Classical Problems of Synchronization using Mutexand Semaphore.
5.	Write a program to simulate CPU Scheduling Algorithms: FCFS, SJF (Preemptive), Priority (Non-Preemptive) and Round Robin (Preemptive).
6.	Write a program to simulate Memory placement strategies – best fit, first fit, next fit and worst fit.
7.	Write a program to simulate Page replacement algorithm.
	Part II : Elective I
	Suggested List of Laboratory Experiments/Assignments **(Any Two assignments from each elective subject are compulsory andInstructor will take care that all the assignments should be covered among different batch students)**
	Internet of Things and Embedded Systems
1.	Understanding the connectivity of Raspberry-Pi / Adriano with IR sensor. Write an application to detect obstacle and notify user using LEDs.
2.	Understanding the connectivity of Raspberry-Pi /Beagle board circuit with temperature sensor. Write an application to read the environment temperature. If temperature crosses a threshold value, generate alerts using LEDs.
3.	Understanding and connectivity of Raspberry-Pi /Beagle board with camera. Write an application to capture and store the image.
4.	Create a small dashboard application to be deployed on cloud. Different publisher devices can publish their information and interested application can subscribe.
	Human Computer Interface
1.	Design a paper prototype for selected Graphical User Interface.
2.	Implement GOMS (Goals, Operators, Methods and Selection rules) modeling technique to model user's behavior in given scenario.
3.	Design a User Interface in Python.
4.	To redesign existing Graphical User Interface with screen complexity.
	Distributed System
1.	Implementation of Inter-process communication using socket programming: implementing multithreaded echo server.
2.	Implementation of RPC Mechanism.
3.	Simulation of election algorithms (Ring and Bully).
4.	Implementation of Clock Synchronization: a) NTP b) Lamports clock.
	Software Project Management
1.	**Create Project Plan** ▪ Specify project name and start (or finish) date. ▪ Identify and define project tasks. ▪ Define duration for each project task. ▪ Define milestones in the plan ▪ Define dependency between tasks ▪ Define project calendar. ▪ Define project resources and specify resource type ▪ Assign resources against each task and baseline the project plan

2.	**Execute and Monitor Project Plan** ▪ Update % Complete with current task status. ▪ Review the status of each task. ▪ Compare Planned vs Actual Status ▪ Review the status of Critical Path ▪ Review resources assignation status
3.	**Generate Dashboard and Reports** • **Dashboard** o Project Overview o Cost Overview o Upcoming Tasks • **Resource Reports** o Over-allocated Resources o Resource Overview • **Cost Reports** o Earned Value Report o Resource Cost Overview o Task Cost Overview • **Progress Reports** o Critical Tasks o Milestone Report o Slipping Tasks

@The CO-PO Mapping Matrix

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

Savitribai Phule Pune University
Third Year of Computer Engineering (2019 Course)
Elective II
310254(D): Software Modeling and Architecture

Home

Teaching Scheme:	Credit: 03	Examination Scheme:
Theory: 04 Hours/Week$$		Mid-Semester (TH) : 30 Marks End-Sem (TH): 70 Marks

Prerequisites Courses: Object Oriented Programming (210243), Software Engineering (210253)

Companion Course: Laboratory Practice II (310258)

Course Objectives:

- To understand and apply Object Oriented concept for designing Object Oriented based model or application
- To transform Requirement document to appropriate design
- To acquaint with the interaction between quality attributes and software architecture
- To understand different architectural designs, transform them into proper model and document them
- To understand software architecture with case studies and explore with examples, use of design pattern application

Course Outcomes:

On completion of the course, learners should be able to

CO1: Analyze the problem statement (SRS) and choose proper design technique for designing web-based/ desktop application
CO2: Design and analyze an application using UML modeling as fundamental tool
CO3: Evaluate software architectures
CO4: Use appropriate architectural styles and software design patterns
CO5: Apply appropriate modern tool for designing and modeling

Course Contents

Unit I	Concepts of Software Modeling	07 Hours

Software Modeling: Introduction to Software Modeling, Advantages of modeling, Principles of modeling. **Evolution of Software Modeling and Design Methods**: Object oriented analysis and design methods, Concurrent, Distributed Design Methods and Real-Time Design Methods, Model Driven Architecture (MDA), 4+1 Architecture, Introduction to UML, UML building Blocks, COMET Use Case–Based Software Life Cycle. **Requirement Study**: Requirement Analysis, SRS design, Requirements Modeling. **Use Case**: Actor and Use case identification, Use case relationship (Include, Extend, Use case Generalization, Actor Generalization), Use case template.

#Exemplar/Case Studies	Requirement modeling and use case modeling for Real life applications (e.g., Online shopping system)
***Mapping of Course Outcomes for Unit I**	CO1, CO2

Unit II	Static Modeling	07 Hours

Study of classes (analysis level and design level classes). **Methods for identification of classes**: RUP (Rational Unified Process), CRC (Class, Responsibilities and Collaboration), Use of Noun Verb analysis (for identifying entity classes, controller classes and boundary classes). **Class Diagram**: Relationship between classes, Generalization/Specialization Hierarchy, Composition and Aggregation Hierarchies, Associations Classes, Constraints.

Object diagram, Package diagram, Component diagram, Composite Structure diagram, Deployment Diagram.

#Exemplar/Case Studies	UML Static Diagrams for Real life applications (e.g., Online shopping system).
***Mapping of Course Outcomes for Unit II**	CO1 ,CO2

Unit III	**Dynamic Modeling**	**07 Hours**

Activity diagram: Different Types of nodes, Control flow, Activity Partition, Exception handler, Interruptible activity region, Input and output parameters, Pins.
Interaction diagram: Sequence diagram, Interaction Overview diagram, State machine diagram, Advanced State Machine diagram, Communication diagram, Timing diagram.

#Exemplar/Case Studies	UML dynamic Diagrams of for Real life applications.
***Mapping of Course Outcomes for Unit III**	CO1 ,CO2

Unit IV	**Software Architecture and Quality Attributes**	**07 Hours**

Introduction to Software Architecture, Importance of Software Architecture, Architectural Structure and Views. **Architectural Pattern**: common module, Common component-and-connector, Common allocation.
Quality Attributes: Architecture and Requirements, Quality Attributes and Considerations

#Exemplar/Case Studies	Case study of any real-life application
***Mapping of Course Outcomes for Unit IV**	CO3

Unit V	**Architectural Design and Documentation**	**07 Hours**

Architecture in the Life Cycle: Architecture in Agile Projects, Architecture and Requirements, Designing an Architecture. **Documenting Software Architecture**: Notations, Choosing and Combining views, Building the documentation Package, Documenting Behavior, Documenting Architecture in an Agile Development Project.

#Exemplar/Case Studies	Air Traffic Control.
***Mapping of Course Outcomes for Unit V**	CO4 , CO5

Unit VI	**Design Patterns**	**07 Hours**

Design Patterns: Introduction, Different approaches to select Design Patterns. **Creational patterns**: Singleton, Factory, Structural pattern: Adapter, Proxy. **Behavioral Patterns**: Iterator, Observer Pattern with applications.

#Exemplar/Case Studies	Flight Simulation
***Mapping of Course Outcomes for Unit VI**	CO4, CO5

Learning Resources

Text Books :

1. Jim Arlow, Ila Neustadt, "UML 2 and the unified process –practical object-oriented analysis and design", Addison Wesley, Second edition, ISBN 978-0201770605.
2. Len Bass, Paul Clements, Rick Kazman, "Software Architecture in Practice", Second Edition, Pearson ,ISBN 978-81-775-8996-2
3. Erich Gamma, "Design Patterns", Pearson, ISBN 0-201-63361-2.

Reference Books :

1. Hassan Gomaa, "Software Modeling and Design- UML, Use cases, Patterns and Software Architectures", Cambridge University Press, 2011, ISBN 978-0-521-76414-8
2. Gardy Booch, James Rambaugh, Ivar Jacobson, "The unified modeling language user guide" , Pearson Education, Second edition, 2008, ISBN 0-321-24562
3. Ian Sommerville, "Software Engineering", Addison and Wesley, ISBN 0-13-703515-2

e-Books :

- https://ebookpdf.com/roger-s-pressman-software-engineering
- https://dhomaseghanshyam.files.wordpress.com/2016/02/gomaa-softwaremodellinganddesign.pdf
- https://balu051989.files.wordpress.com/2011/06/the-unified-modeling-language-user-guide-by-grady-booch-james-rumbaugh-ivar-jacobson.pdf
- http://index-of.co.uk/Engineering/Software%20Engineering%20(9th%20Edition).pdf)

MOOCs Courses link

- https://nptel.ac.in/courses/106/105/106105224/
- https://onlinecourses.nptel.ac.in/noc20_cs59/preview
- https://onlinecourses.nptel.ac.in/noc20_cs84/preview

@ The CO-PO Mapping Matrix

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

SYLLABI OF ALL 4 ELECTIVE SUBJECTS ELECTED BY STUDENTS IS GIVEN IN THIS DOCUMENT

Faculty of Engineering
Savitribai Phule Pune University, Pune

Maharashtra, India

Syllabus

for

Fourth Year of Computer Engineering
(2015 Course)

(with effect from 2018-19)

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

Semester I

Course Code	Course	Teaching Scheme Hours / Week		Examination Scheme and Marks						Credit	
		Theory	Practical	In-Sem	End-Sem	TW	PR	OR/ *PRE	Total	TH/ TUT	PR
410241	High Performance Computing	04	--	30	70	--	--	--	100	04	--
410242	Artificial Intelligence and Robotics	03	--	30	70	--	--	--	100	03	--
410243	Data Analytics	03	--	30	70	--	--	--	100	03	--
410244	Elective I	03	--	30	70	--	--	--	100	03	--
410245	Elective II	03	--	30	70	--	--	--	100	03	--
410246	Laboratory Practice I	--	04	--	--	50	50	--	100	--	02
410247	Laboratory Practice II	--	04	--	--	50	--	*50	100	--	02
410248	Project Work Stage I	--	02	--	--	--	--	*50	50	--	02
									Total Credit	**16**	**06**
Total		**16**	**10**	**150**	**350**	**100**	**50**	**100**	**750**	**22**	
410249	Audit Course 5									**Grade**	

Elective I	Elective II
410244 (A) Digital Signal Processing	**410245 (A)** Distributed Systems
410244 (B) Software Architecture and Design	**410245 (B)** Software Testing and Quality Assurance
410244 (C) Pervasive and Ubiquitous Computing	**410245 (C)** Operations Research
410244 (D) Data Mining and Warehousing	**410245 (D)** Mobile Communication

410249-Audit Course 5 (AC5) Options:

AC5-I Entrepreneurship Development

AC5-II: Botnet of Things

AC5-III: 3D Printing

AC5-IV: Industrial Safety and Environment Consciousness

AC5-V: Emotional Intelligence

AC5-VI: MOOC- Learn New Skills

Abbreviations:

TW: Term Work **TH:** Theory **OR:** Oral **PR:** Practical

Sem: Semester **PRE**: Project/ Mini-Project Presentation

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

Semester II

Course Code	Course	Teaching Scheme Hours / Week		Examination Scheme and Marks						Credit	
		Theory	Practical	In-Sem	End-Sem	TW	PR	OR/ *PRE	Total	TH/ TUT	PR
410250	Machine Learning	03	--	30	70	--	--	--	100	03	--
410251	Information and Cyber Security	03	--	30	70	--	--	--	100	03	--
410252	Elective III	03	--	30	70	--	--	--	100	03	--
410253	Elective IV	03	--	30	70	--	--	--	100	03	--
410254	Laboratory Practice III	--	04	--	--	50	50	--	100	--	02
410255	Laboratory Practice IV	--	04	--	--	50	--	*50	100	--	02
410256	Project Work Stage II	--	06	--	--	100	--	*50	150	--	06
								Total	**Credit**	**12**	**10**
Total		**12**	**14**	**120**	**280**	**200**	**50**	**100**	**750**	**22**	
41025 7	Audit Course 6									**Grade**	

Elective III	Elective IV
410252 (A) Advanced Digital Signal Processing	**410253 (A)** Software Defined Networks
410252 (B) Compilers	**410253 (B)** Human Computer Interface
410252 (C) Embedded and Real Time Operating System	**410253 (C)** Cloud Computing
410252 (D) Soft Computing and Optimization Algorithms	**410253 (D)** Open Elective

410259-Audit Course 6 (AC6) Options:

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

Abbreviations:

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

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

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

Prerequisite Courses: 310242-Database Management Systems, 310244- Information Systems and Engineering Economics

Companion Course: 410247-Laboratory Practice II

Course Objectives:

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

Course Outcomes:

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

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

Course Contents

Unit I	Introduction	08 Hours

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

Unit II	Data Warehouse	08 Hours

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

Unit III	Measuring Data Similarity and Dissimilarity	08 Hours

Measuring Data Similarity and Dissimilarity, Proximity Measures for Nominal Attributes and Binary Attributes, interval scaled; Dissimilarity of Numeric Data: Minskowski Distance, Euclidean distance and Manhattan distance; Proximity Measures for Categorical, Ordinal Attributes, Ratio scaled variables; Dissimilarity for Attributes of Mixed Types, Cosine Similarity.

Unit IV	Association Rules Mining	08 Hours

Market basket Analysis, Frequent item set, Closed item set, Association Rules, a-priori Algorithm, Generating Association Rules from Frequent Item sets, Improving the Efficiency of a-priori, Mining Frequent Item sets without Candidate Generation: FP Growth Algorithm; Mining Various Kinds of Association Rules: Mining multilevel association rules, constraint based association rule mining, Meta rule-Guided Mining of Association Rules.

Unit V	Classification	08 Hours

Introduction to: Classification and Regression for Predictive Analysis, Decision Tree Induction, Rule-Based Classification: using IF-THEN Rules for Classification, Rule Induction Using a Sequential Covering Algorithm. Bayesian Belief Networks, Training Bayesian Belief Networks, Classification Using Frequent Patterns, Associative Classification, Lazy Learners-k-Nearest-Neighbor Classifiers, Case-Based Reasoning.

Unit VI	Multiclass Classification	08 Hours

Multiclass Classification, Semi-Supervised Classification, Reinforcement learning, Systematic Learning, Wholistic learning and multi-perspective learning. Metrics for Evaluating Classifier Performance: Accuracy, Error Rate, precision, Recall, Sensitivity, Specificity; Evaluating the Accuracy of a Classifier: Holdout Method, Random Sub sampling and Cross-Validation.

Books:

Text:

1. Han, Jiawei Kamber, Micheline Pei and Jian, “Data Mining: Concepts and Techniques”, Elsevier Publishers, ISBN:9780123814791, 9780123814807.
2. Parag Kulkarni, “Reinforcement and Systemic Machine Learning for Decision Making” by Wiley-IEEE Press, ISBN: 978-0-470-91999-6

References:

1. Matthew A. Russell, "Mining the Social Web: Data Mining Facebook, Twitter, LinkedIn, Google+, GitHub, and More" , Shroff Publishers, 2nd Edition, ISBN: 9780596006068
2. Maksim Tsvetovat, Alexander Kouznetsov, "Social Network Analysis for Startups:Finding connections on the social web", Shroff Publishers , ISBN: 10: 1449306462

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
Elective II
410245(B): Software Testing and Quality Assurance

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

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

Companion Course: 410247-Laboratory Practice II

Course Objectives:

- Introduce basic concepts of software testing
- Understand white box, block box, object oriented, web based and cloud testing
- Know in details automation testing and tools used for automation testing
- Understand the importance of software quality and assurance software systems development.

Course Outcomes:

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

- Describe fundamental concepts in software testing such as manual testing, automation testing and software quality assurance.
- Design and develop project test plan, design test cases, test data, and conduct test operations
- Apply recent automation tool for various software testing for testing software
- Apply different approaches of quality management, assurance, and quality standard to software system
- Apply and analyze effectiveness Software Quality Tools

Course Contents

Unit I	Introduction	08 Hours

Introduction, historical perspective, Definition, Core Components, Quality View, Financial Aspect, Customers suppliers and process, Total Quality Management(TQM), Quality practices of TQM, Quality Management through- Statistical process Control, Cultural Changes, Continual Improvement cycle, quality in different areas, Benchmarking and metrics, Problem Solving Techniques, Problem Solving Software Tools.

Software Quality- Introduction, Constraints of Software product Quality assessment, Customer is a King, Quality and Productivity Relationship, Requirements of Product, Organization Culture, Characteristics of Software, Software Development Process, Types of Product, Criticality Definitions, Problematic areas of SDLC, Software Quality Management, Why Software has defects, Processes related to Software Quality, Quality Management System's Structure, Pillars of Quality Management System, Important aspects of quality management.

Unit II	Test Planning and Management	08 Hours

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

Unit III	Software Test Automation	08 Hours

What is Test Automation, Terms used in automation, Skills needed for automation, What to automate, scope of automation, Design and Architecture of automation, Generic requirement for Test Tool, Process Model for Automation, Selecting Test Tool, Automation for XP/Agile model, Challenges in Automation, Data-driven Testing. Automation Tools like JUnit, Jmeter

Unit IV	Selenium Tool	08 Hours

Introducing Selenium, Brief History of The Selenium Project, Selenium's Tool Suite, Selenium-IDE, Selenium RC, Selenium Webdriver, Selenium Grid, Test Design Considerations

Unit V	Quality Management	08 Hours

Software Quality, Software Quality Dilemma, Achieving Software Quality, Software Quality Assurance. Elements of SQA, SQA Tasks, Goals, and Metrics, Formal Approaches to SQA, Statistical Software Quality Assurance, Six Sigma for Software Engineering, ISO 9000 Quality Standards, SQA Plan.

Unit VI	Software Quality Tools	08 Hours

Total Quality Management, Product Quality Metrics, In process Quality Metrics, Software maintenance, Ishikawa's 7 basic tools, Checklists, Pareto diagrams, Histogram, Run Charts, Scatter diagrams, Control chart, Cause Effect diagram. Defect Removal Effectiveness and Process Maturity Level.

Books:

Text:

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

References:

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

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

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

Prerequisite Courses: 310250-Design and Analysis of Algorithm

Companion Course: 410255-Laboratory Practice IV

Course Objectives:

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

Course Outcomes:

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

- Apply soft computing methodologies, including artificial neural networks, fuzzy sets, fuzzy logic, fuzzy inference systems and genetic algorithms
- Design and development of certain scientific and commercial application using computational neural network models, fuzzy models, fuzzy clustering applications and genetic algorithms in specified applications.

Course Contents

Unit I	Introduction	08 Hours

Introduction, soft computing vs. hard computing, various types of soft computing techniques, and applications of soft computing. Basic tools of soft computing – Fuzzy logic, neural network, evolutionary computing. Introduction: Neural networks, application scope of neural networks, fuzzy logic, genetic algorithm, and hybrid systems.

Unit II	Fuzzy Sets and Logic	08 Hours

Basic concepts of fuzzy logic, Fuzzy sets and Crisp sets, Fuzzy set theory and operations, Properties of fuzzy sets, Fuzzy and Crisp relations, Fuzzy to Crisp conversion. Membership functions, interference in fuzzy logic, fuzzy if-then rules, Fuzzy implications and Fuzzy algorithms, Fuzzyfications and Defuzzifications.

Unit III	Fuzzy Systems	08 Hours

Fuzzy Controller, Fuzzy rule base and approximate reasoning: truth values and tables in fuzzy logic, fuzzy propositions formation of rules, decomposition of compound rules, aggregation of fuzzy rules, fuzzy reasoning, fuzzy inference system, fuzzy expert systems.

Unit IV	Evolutionary Computing	08 Hours

Basic Evolutionary Processes, EV : A Simple Evolutionary System, Evolutionary Systems as Problem Solvers, A Historical Perspective, Canonical Evolutionary Algorithms - Evolutionary Programming, Evolution Strategies, A Unified View of Simple EAs- A Common Framework, Population Size.

Unit V	Genetic Algorithm	08 Hours

Basic concepts, working principle, procedures of GA, flow chart of GA, Genetic representations, (encoding) Initialization and selection, Genetic operators, Mutation, Generational Cycle, Traditional algorithm vs genetic algorithm, simple GA, general genetic algorithm, schema theorem, Classification of genetic algorithm, Holland classifier systems, genetic programming, applications of genetic algorithm, Convergence of GA. Applications and advances in GA, Differences and similarities between GA and other traditional method, applications.

Unit VI	Swarm Intelligence	08 Hours

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

Books:

Text:

1. S.N. Sivanandam- “Principles of Soft Computing”, Wiley India- ISBN- 9788126527410
2. S. Rajsekaran and G.A. Vijayalakshmi Pai, “Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications” , Prentice Hall of India, ISBN: 0451211243
3. J S R Jang, CT Sun and E.Mizutani, “Neuro-Fuzzy and Soft Computing” , PHI PVT LTD, ISBN 0-13-261066-3.
4. De Jong , “Evolutionary Computation: A Unified Approach”, Cambridge (Massachusetts): MIT Press. ISBN: 0-262-04194-4. 2006
5. Maurice Clerc, “Particle Swarm Optimization”, ISTE, Print ISBN:9781905209040 |Online ISBN:9780470612163 |DOI:10.1002/9780470612163

References:

1. Andries P. Engelbrecht, “Computational Intelligence: An Introduction”, 2nd Edition-Wiley India- ISBN: 978-0-470-51250-0
2. N.P.Padhy, “Artificial Intelligence and Intelligent Systems” Oxford University Press, ISBN 10: 0195671546
3. Siman Haykin, “Neural Networks”, Prentice Hall of India, ISBN: 0-7923-9475-5
4. Timothy J. Ross, “Fuzzy Logic with Engineering Applications” , Wiley India, ISBN: 978-0-470-74376-8
5. Eiben and Smith, “Introduction to Evolutionary Computation", Springer, ISBN-10: 3642072852

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

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

Prerequisite Courses:

Companion Course: 410255-Laboratory Practice IV

Course Objectives:

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

Course Outcomes:

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

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

Course Contents

Unit I	Basics of Cloud Computing	08 Hours

Overview, Applications, Intranets and the Cloud. Your Organization and Cloud Computing- Benefits, Limitations, Security Concerns. Software as a Service (SaaS)- Understanding the Multitenant Nature of SaaS Solutions, Understanding SOA. Platform as a Service (PaaS)-IT Evolution Leading to the Cloud, Benefits of Paas Solutions, Disadvantages of PaaS Solutions. Infrastructure as a Service (IaaS)-Understanding IaaS, Improving Performance through Load Balancing, System and Storage Redundancy, Utilizing Cloud-Based NAS Devices, Advantages, Server Types. Identity as a Service (IDaaS).

Unit II	Data Storage and Security in Cloud	08 Hours

Cloud file systems: GFS and HDFS, BigTable, HBase and Dynamo Cloud data stores: Datastore and Simple DB Gautam Shrauf, Cloud Storage-Overview, Cloud Storage Providers. [Anthony T. Velte]3 Securing the Cloud- General Security Advantages of Cloud-Based Solutions, Introducing Business Continuity and Disaster Recovery. Disaster Recovery- Understanding the Threats.

Unit III	Virtualization	08 Hours

Implementation Levels of Virtualization, Virtualization Structures/Tools and Mechanisms, Types of Hypervisors, Virtualization of CPU, Memory, and I/O Devices, Virtual Clusters and Resource Management, Virtualization for Data-Center Automation. Common Standards: The Open Cloud Consortium, Open Virtualization Format, Standards for Application Developers: Browsers (Ajax), Data (XML, JSON), Solution Stacks (LAMP and LAPP),Syndication (Atom, Atom Publishing Protocol, and RSS), Standards for Security.

Unit IV	Amazon Web Services	08 Hours

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

Unit V	Ubiquitous Clouds and the Internet of Things	08 Hours

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

Unit VI	Future of Cloud Computing	08 Hours

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

Books:

Text:

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

References:

1. Dr. Kumar Saurabh,"Cloud Computing", Wiley Publication, ISBN10: 8126536039
2. Buyya, “Mastering Cloud Computing”, Tata McGraw Hill, ISBN-13: 978-1-25-902995-0,
3. Barrie Sosinsky,"Cloud Computing", Wiley India, ISBN: 978-0-470-90356-8
4. Kailash Jayaswal, “Cloud computing", Black Book, Dreamtech Press
5. Thomas Erl, Zaigham Mahmood and Ricardo Puttini, “Cloud Computing: Concepts, Technology and Architecture”, Pearson, 1st Edition, ISBN :978 9332535923, 9332535922
4. Tim Mather, Subra K, Shahid L.,Cloud Security and Privacy, Oreilly, ISBN-13 978-81-8404-815-5