

# 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**

**Third Year of Computer Engineering  
(2019 Course)  
(With effect from 2021-22)**

## **Prologue**

It is with great pleasure and honor that I share the syllabi for Third Year of Computer Engineering (2019 Course) on behalf of Board of Studies, Computer Engineering. We, members of BoS are giving our best to streamline the processes and curricula design.

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

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

Case Studies are included in almost all courses. Course Instructor is recommended to discuss appropriate related recent technology/upgrade/Case Studies to encourage students to study from course to the scenario and think through the largest issues/recent trends/ utility/ developing real world/ professional skills.

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

**Thanks,**

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

**links for First and Second Year Computer Engineering Curriculum 2019:**

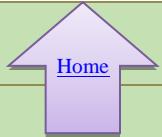
1. [http://collegecirculars.unipune.ac.in/sites/documents/Syllabus%202019/Rules%20and%20Regulations%20F.E.%202019%20Patt\\_10.012020.pdf](http://collegecirculars.unipune.ac.in/sites/documents/Syllabus%202019/Rules%20and%20Regulations%20F.E.%202019%20Patt_10.012020.pdf)
2. [http://collegecirculars.unipune.ac.in/sites/documents/Syllabus%202019/First%20Year%20Engineering%202019%20Patt.Syllabus\\_05.072019.pdf](http://collegecirculars.unipune.ac.in/sites/documents/Syllabus%202019/First%20Year%20Engineering%202019%20Patt.Syllabus_05.072019.pdf)
3. [http://collegecirculars.unipune.ac.in/sites/documents/Syllabus2020/SE%20Computer%20Engg.%202019%20%20Patt\\_03.072020.pdf](http://collegecirculars.unipune.ac.in/sites/documents/Syllabus2020/SE%20Computer%20Engg.%202019%20%20Patt_03.072020.pdf)

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

**Table of Contents**

<b>Sr. No.</b>	<b>Title</b>	<b>Page Number</b>
1.	<a href="#"><u>Program Outcomes</u></a>	04
2.	<a href="#"><u>Program Specific Outcomes</u></a>	04
3.	<a href="#"><u>Course Structure</u></a> (Course titles, scheme for teaching, credit, examination and marking)	05
4.	<a href="#"><u>General Guidelines</u></a>	07
5.	<b>Course Contents (Semester V)</b>	
	<a href="#"><u>310241: Database Management Systems</u></a>	10
	<a href="#"><u>310242: Theory of Computation</u></a>	13
	<a href="#"><u>310243: Systems Programming and Operating System</u></a>	16
	<a href="#"><u>310244: Computer Networks and Security</u></a>	19
	<a href="#"><u>310245A: Elective I- Internet of Things and Embedded Systems</u></a>	22
	<a href="#"><u>310245B: Elective I- Human Computer Interface</u></a>	25
	<a href="#"><u>310245C: Elective I- Distributed Systems</u></a>	28
	<a href="#"><u>310245D: Elective I- Software Project Management</u></a>	31
	<a href="#"><u>310246: Database Management Systems Laboratory</u></a>	33
	<a href="#"><u>310247: Computer Networks and Security Laboratory</u></a>	37
	<a href="#"><u>310248: Laboratory Practice I</u></a>	40
	<a href="#"><u>310249: Seminar and Technical Communication</u></a>	44
	<a href="#"><u>310250: Audit Course 5</u></a>	46
6.	<b>Course Contents (Semester VI)</b>	
	<a href="#"><u>310251: Data Science and Big Data Analytics</u></a>	53
	<a href="#"><u>310252: Web Technology</u></a>	56
	<a href="#"><u>310253: Artificial Intelligence</u></a>	59
	<a href="#"><u>310254A: Elective II- Information Security</u></a>	62
	<a href="#"><u>310254B: Elective II- Augmented and Virtual Reality</u></a>	65
	<a href="#"><u>310254C: Elective II- Cloud Computing</u></a>	68
	<a href="#"><u>310254D: Elective II- Software Modeling and Architectures</u></a>	71
	<a href="#"><u>310255: Internship</u></a>	74
	<a href="#"><u>310256: Data Science and Big Data Analytics Laboratory</u></a>	77
	<a href="#"><u>310257: Web Technology Laboratory</u></a>	82
	<a href="#"><u>310258: Laboratory Practice II</u></a>	85
	<a href="#"><u>310259: Audit Course 6</u></a>	91
7.	<a href="#"><u>Acknowledgement</u></a>	97
8.	<a href="#"><u>Task Force at Curriculum Design</u></a>	98

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



**Learners are expected to know and be able to**

<b>PO1</b>	<b>Engineering knowledge</b>	Apply the knowledge of mathematics, science, Engineering fundamentals, and an Engineering specialization to the solution of complex Engineering problems.
<b>PO2</b>	<b>Problem analysis</b>	Identify, formulate, review research literature and analyze complex Engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and Engineering sciences.
<b>PO3</b>	<b>Design / Development of Solutions</b>	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.
<b>PO4</b>	<b>Conduct Investigations of Complex Problems</b>	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.
<b>PO5</b>	<b>Modern Tool Usage</b>	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.
<b>PO6</b>	<b>The Engineer and Society</b>	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.
<b>PO7</b>	<b>Environment and Sustainability</b>	Understand the impact of the professional Engineering solutions in societal and Environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
<b>PO8</b>	<b>Ethics</b>	Apply ethical principles and commit to professional ethics and responsibilities and norms of Engineering practice.
<b>PO9</b>	<b>Individual and Team Work</b>	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
<b>PO10</b>	<b>Communication Skills</b>	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.
<b>PO11</b>	<b>Project Management and Finance</b>	Demonstrate knowledge and understanding of 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.
<b>PO12</b>	<b>Life-long Learning</b>	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)**

**A graduate of the Computer Engineering Program will demonstrate-**

<b>PSO1</b>	<b>Professional Skills</b> -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.
<b>PSO2</b>	<b>Problem-Solving Skills</b> - 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.
<b>PSO3</b>	<b>Successful Career and Entrepreneurship</b> - The ability to employ modern computer languages, environments and platforms in creating innovative career paths to be an entrepreneur and to have a zest for higher studies.

## 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	
310241	<a href="#">Database Management Systems</a>	03	-	-	30	70	-	-	-	100	03	-	-	03
310242	<a href="#">Theory of Computation</a>	03	-	-	30	70	-	-	-	100	03	-	-	03
310243	<a href="#">Systems Programming and Operating System</a>	03	-	-	30	70	-	-	-	100	03	-	-	03
310244	<a href="#">Computer Networks and Security</a>	03	-	-	30	70	-	-	-	100	03	-	-	03
310245	<a href="#">Elective I</a>	03	-	-	30	70	-	-	-	100	03	-	-	03
310246	<a href="#">Database Management Systems Laboratory</a>	-	04	-	-	-	25	25	-	50	-	02	-	02
310247	<a href="#">Computer Networks and Security Laboratory</a>	-	02	-	-	-	25	-	25	50	-	01	-	01
310248	<a href="#">Laboratory Practice I</a>	-	04	-	-	-	25	25	-	50	-	02	-	02
310249	<a href="#">Seminar and Technical Communication</a>	-	-	01	-	-	50	-	-	50	-	-	01	01
<b>Total</b>		<b>15</b>	<b>10</b>	<b>01</b>	<b>150</b>	<b>350</b>	<b>125</b>	<b>50</b>	<b>25</b>	<b>700</b>	<b>15</b>	<b>05</b>	<b>01</b>	<b>21</b>
310250	<a href="#">Audit Course 5</a>											<b>Grade</b>		
													<b>Total Credit</b>	
<b>310245 Elective I Options:</b> 310245(A) <a href="#">Internet of Things and Embedded Systems</a> 310245(B) <a href="#">Human Computer Interface</a> 310245(C) <a href="#">Distributed Systems</a> 310245(D) <a href="#">Software Project Management</a>							<b>310250 Audit Course 5 Options:</b> 310250 (A) <a href="#">Cyber Security</a> 310250 (B) <a href="#">Professional Ethics and Etiquettes</a> 310250 (C) <a href="#">Learn New Skills</a> 310250 (D) <a href="#">Engineering Economics</a> 310250 (E) <a href="#">Foreign Language</a>							
<b>Laboratory Practice I</b> Assignments from <b>Systems Programming and Operating System</b> and <b>Elective I</b>														

## 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	<a href="#">Data Science and Big Data Analytics</a>	04	-	-	30	70	-	-	-	100	03	-	-	03			
310252	<a href="#">Web Technology</a>	04	-	-	30	70	-	-	-	100	03	-	-	03			
310253	<a href="#">Artificial Intelligence</a>	04	-	-	30	70	-	-	-	100	03	-	-	03			
310254	<a href="#">Elective II</a>	04	-	-	30	70	-	-	-	100	03	-	-	03			
310255	<a href="#">Internship**</a>	-	-	-	-	-	100 **	-	-	100	-	-	-	04 **			
310256	<a href="#">Data Science and Big Data Analytics Laboratory</a>	-	04	-	-	-	50	25	-	75	-	02	-	02			
310257	<a href="#">Web Technology Laboratory</a>	-	02	-	-	-	25	-	25	50	-	01	-	01			
310258	<a href="#">Laboratory Practice II</a>	-	04	-	-	-	50	25	-	75	-	02	-	02			
<b>Total</b>		<b>12</b>	<b>10</b>	<b>-</b>	<b>120</b>	<b>280</b>	<b>225</b>	<b>50</b>	<b>25</b>	<b>700</b>	<b>12</b>	<b>09</b>	<b>-</b>	<b>21</b>			
310259	<a href="#">Audit Course 6</a>											<b>Grade</b>					
													<b>Total</b>	<b>12</b>	<b>09</b>	<b>-</b>	<b>21</b>

**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:**

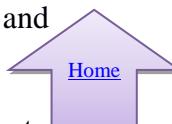
As per the apex bodies' recommendations and guidelines, it is need of the day to train the pre-final year students for the industrial readiness through internship. As per the guidelines of AICTE, the duration of internship is 4-6 weeks after completion of semester V and before commencement of semester 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 be 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.**

## General Guidelines

1. Every undergraduate program has its own objectives and educational outcomes. These objectives and outcomes are furnished by considering various aspects and impacts of the curriculum. The **Program Outcomes (POs)** for Engineering are categorically mentioned at the beginning of the curriculum (ref: NBA Manual). There should always be a rationale and a goal behind the inclusion of a course in the curriculum. Course Outcomes though highly rely on the contents of the course; many-a-times are generic and bundled. The **Course Objectives, Course Outcomes** and **CO-PO mappings matrix** justifies the motives, accomplishment and prospect behind learning the course. The Course Objectives, Course Outcomes and CO-PO Mapping Matrix are provided for reference and these are indicative only. The course instructor may modify them as per his or her perspective.
2. @: **CO and PO Mapping Matrix**(Course Outcomes and Program Outcomes)- The **expected** attainment mapping matrix at end of course contents, indicates the correlation levels of 3, 2, 1 and ‘-’. The notation of 3, 2 and 1 denotes substantially (high), moderately (medium) and slightly (low). The mark ‘-’indicates that there is no correlation between the respective CO and PO.
3. #: **Elaborated examples/Case Studies**- For each course, contents are divided into six units-I, II, III, IV, V and VI. Elaborated examples/Case Studies are included at the end of each unit to explore how the learned topics apply to real world situations and need to be explored to assist students to increase their competencies, inculcating the specific skills, building the knowledge to be applicable in any given situation along with an articulation. One or two sample exemplars or case studies are included for each unit; instructor may extend the same with more. **Exemplar/Case Studies** may be assigned as self-study by students and to be excluded from theory examinations.
4. \*: For each unit contents, the desired content attainment mapping is indicated with Course Outcome(s). Instructor may revise the same as per their viewpoint.
5. For laboratory courses, set of suggested assignments is provided for reference. Laboratory Instructors may design suitable set of assignments for respective course at their level. **Beyond curriculum assignments and mini-project may be included as a part of laboratory work.** The Inclusion of few optional assignments that are intricate and/or beyond the scope of curriculum will surely be the value addition for the students and it will satisfy the intellectuals within the group of the learners and will add to the perspective of the learners.
6. For each laboratory assignment, it is essential for students to draw/write/generate flowchart, algorithm, test cases, mathematical model, Test data set and comparative/complexity analysis (as applicable). Batch size for practical and tutorial may be as per guidelines of authority.
7. For each course, irrespective of the examination head, the instructor should motivate students to read and publish articles, research papers related to recent development and invention in the field.
8. For laboratory, instructions have been included about the conduction and assessment of laboratory work. **These guidelines are to be strictly followed.** **Use of open source software is appreciated.**
9. **Term Work** <sup>[1]</sup>—Term work is continuous assessment that evaluates a student's progress throughout the semester <sup>[1]</sup>. Term work assessment criteria specify the standards that must be met and the evidence that will be gathered to demonstrate the achievement of course outcomes. Categorical assessment criteria for the term work should establish unambiguous standards of achievement for each course outcome. They should describe what the learner is expected to perform in the laboratories or on the fields to show that the course outcomes have been

achieved. It is recommended to conduct internal monthly mock practical test as part of continuous assessment.

Students' work will be evaluated typically based on the criteria like attentiveness, proficiency in execution of the task, regularity, punctuality, use of referencing, accuracy of language, use of supporting evidence in drawing conclusions, quality of critical thinking and similar performance measuring criteria.



**10. Laboratory Journal**- Program codes with sample output of all performed assignments are to be submitted as softcopy. Use of DVD or similar media 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. As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Submission of journal/ term work in the form of softcopy is desirable and appreciated.

**11. Tutorial** <sup>[1]</sup> - Tutorials can never be an individual course but an additional aid to the learners. Tutorials help the learners to inculcate the contents of the course with focused efforts on small group of the learners. Tutorial conduction should concentrate more on simplifying the intricacies converging to clear understanding and application. Assessment of tutorial work is to be done in a manner similar to assessment of term-work; do follow same guidelines.

**12. Audit Course** <sup>[1]</sup>-The student registered for audit course shall be awarded the grade AP/PP (Audit Course Pass) and the grade 'AP'/'PP' shall be included 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'/'PP' 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.

**13.** UGC has issued the UGC (Credit Framework for online learning courses through SWAYAM) Regulation 2016 advising the Universities to identify courses where credits can be transferred on to the academic record of the students for courses done on SWAYAM. AICTE has also put out gazette notification in 2016 and subsequently for adoption of these courses for credit transfer<sup>[2]</sup>.

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. This is done through a platform that facilitates hosting of the courses to be accessed by anyone, anywhere at any time. Courses delivered through SWAYAM are interactive, prepared by the best teachers in the country and are available, free of cost to any learner. However, learners wanting a SWAYAM certificate should register for the final proctored exams that come at a fee and attend in-person at designated center on specified dates. Eligibility for the certificate is generally announced on the course page. Universities/colleges approving credit transfer for these courses can use the marks/certificate obtained in these courses for the same.<sup>[2]</sup>

For more rules, pattern and assessment of semester examination refer<sup>[1]</sup>

**14. \*\*Internship:**

Engineering internships are intended to provide students with an opportunity to apply conceptual knowledge from academics to the realities of the field work/training. The following guidelines are proposed to give academic credit for the internship undergone as a part of the Third Year Engineering curriculum.

[1][http://collegecirculars.unipune.ac.in/sites/documents/Syllabus%202019/Rules%20and%20Regulations%20F.E.%202019%20Patt\\_10.012020.pdf](http://collegecirculars.unipune.ac.in/sites/documents/Syllabus%202019/Rules%20and%20Regulations%20F.E.%202019%20Patt_10.012020.pdf)

[2] <https://swayam.gov.in/about>

Abbreviations		
<b>TW: Term Work</b>	<b>TH: Theory</b>	<b>PR: Practical</b>
<b>OR: Oral</b>	<b>TUT: Tutorial</b>	<b>Sem: Semester</b>

# Semester V

Teaching Scheme:

Theory: 03 Hours/Week

Credit: 03

Examination Scheme:

Mid-Sem (TH) : 30 Marks

End-Sem (TH): 70 Marks

**Prerequisites Courses:** Discrete Mathematics (210241), Data Structures and Algorithms (210252)

**Companion Course:** Database Management Systems Laboratory (310246)

### Course Objectives:

- To understand the fundamental concepts of Database Management Systems
- To acquire the knowledge of database query languages and transaction processing
- To understand systematic database design approaches
- To acquire the skills to use a powerful, flexible, and scalable general-purpose databases to handle Big Data
- To be familiar with advances in databases and applications

### Course Outcomes:

On completion of the course, learners should be able to

**CO1:** Analyze and design Database Management System using ER model

**CO2:** Implement database queries using database languages

**CO3:** Normalize the database design using normal forms

**CO4:** Apply Transaction Management concepts in real-time situations

**CO5:** Use NoSQL databases for processing unstructured data

**CO6:** Differentiate between Complex Data Types and analyze the use of appropriate data types

### Course Contents

Unit I	Introduction to Database Management Systems and ER Model	06 Hours
Introduction, Purpose of Database Systems, Database-System Applications, View of Data, Database Languages, Database System Structure, Data Models. <b>Database Design and ER Model:</b> Entity, Attributes, Relationships, Constraints, Keys, Design Process, Entity-Relationship Model, ER Diagram, Design Issues, Extended E-R Features, converting ER and EER diagram into tables.		
#Exemplar/Case Studies	Analyze and design database using ER Model for any real-time application and convert the same into tables.	
*Mapping of Course Outcomes for Unit I	CO1	
Unit II	SQL and PL/SQL	07 Hours
<b>SQL:</b> Characteristics and Advantages, SQL Data Types and Literals, DDL, DML, DCL, TCL, SQL Operators. <b>Tables:</b> Creating, Modifying, Deleting, Updating. <b>SQL DML Queries:</b> SELECT Query and clauses, Index and Sequence in SQL. <b>Views:</b> Creating, Dropping, Updating using Indexes, Set Operations, Predicates and Joins, Set membership, Tuple Variables, Set comparison, Ordering of Tuples, Aggregate Functions, SQL Functions, Nested Queries. <b>PL/SQL:</b> Concept of Stored Procedures and Functions, Cursors, Triggers, Assertions, Roles and Privileges.		
#Exemplar/Case Studies	Implementation of Unit 1 case study using SQL and PL/SQL.	

<b>*Mapping of Course Outcomes for Unit II</b>		CO1, CO2
<b>Unit III</b>	<b>Relational Database Design</b>	<b>06 Hours</b>
<b>Relational Model:</b> Basic concepts, Attributes and Domains, CODD's Rules. <b>Relational Integrity:</b> Domain, Referential Integrities, Enterprise Constraints. <b>Database Design:</b> Features of Good Relational Designs, Normalization, Atomic Domains and First Normal Form, Decomposition using Functional Dependencies, Algorithms for Decomposition, 2NF, 3NF, BCNF.		
<b>#Exemplar/Case Studies</b>		Normalize relational database designed in Unit I.
<b>*Mapping of Course Outcomes for Unit III</b>		CO1, CO3
<b>Unit IV</b>	<b>Database Transaction Management</b>	<b>07 Hours</b>
Introduction to Database Transaction, Transaction states, ACID properties, Concept of Schedule, Serial Schedule. <b>Serializability:</b> Conflict and View, Cascaded Aborts, Recoverable and Non-recoverable Schedules. <b>Concurrency Control:</b> Lock-based, Time-stamp based Deadlock handling. <b>Recovery methods:</b> Shadow-Paging and Log-Based Recovery, Checkpoints. <b>Log-Based Recovery:</b> Deferred Database Modifications and Immediate Database Modifications.		
<b>#Exemplar/Case Studies</b>		Study of Transaction Management in Postgre SQL
<b>*Mapping of Course Outcomes for Unit IV</b>		CO3, CO4
<b>Unit V</b>	<b>NoSQL Databases</b>	<b>07 Hours</b>
Introduction to Distributed Database System, Advantages, Disadvantages, CAP Theorem. <b>Types of Data:</b> Structured, Unstructured Data and Semi-Structured Data. <b>NoSQL Database:</b> Introduction, Need, Features. <b>Types of NoSQL Databases:</b> Key-value store, document store, graph, wide column stores, BASE Properties, Data Consistency model, ACID Vs BASE, Comparative study of RDBMS and NoSQL. <b>MongoDB</b> (with syntax and usage): CRUD Operations, Indexing, Aggregation, MapReduce, Replication, Sharding.		
<b>#Exemplar/Case Studies</b>		Use of NoSQL databases for processing unstructured data from social media.
<b>*Mapping of Course Outcomes for Unit V</b>		CO5, CO6
<b>Unit VI</b>	<b>Advances in Databases</b>	<b>07 Hours</b>
<b>Emerging Databases:</b> Active and Deductive Databases, Main Memory Databases, Semantic Databases. <b>Complex Data Types:</b> Semi-Structured Data, Features of Semi-Structured Data Models. <b>Nested Data Types:</b> JSON, XML. <b>Object Orientation:</b> Object-Relational Database System, Table Inheritance, Object-Relational Mapping. <b>Spatial Data:</b> Geographic Data, Geometric Data.		
<b>#Exemplar/Case Studies</b>		Applications of advanced databases in real time environment.

<b>*Mapping of Course Outcomes for Unit VI</b>	CO5, CO6
<b>Learning Resources</b>	

**Text Books :**

1. Silberschatz A., Korth H., Sudarshan S., "Database System Concepts", McGraw Hill Publishers, ISBN 0-07-120413-X, 6th edition
2. Connally T, Begg C., "Database Systems", Pearson Education, ISBN 81-7808-861-4
3. Pramod J. Sadalage and Martin Fowler, "NoSQL Distilled", Addison Wesley, ISBN-10: 0321826620, ISBN-13: 978-0321826626

**Reference Books :**

1. C J Date, "An Introduction to Database Systems", Addison-Wesley, ISBN: 0201144719
2. S.K.Singh, "Database Systems: Concepts, Design and Application", Pearson Education, ISBN 978-81-317-6092-5
3. Kristina Chodorow, Michael Dierolf, "MongoDB: The Definitive Guide", O'Reilly Publications, ISBN: 978-1-449-34468-9
4. Adam Fowler, "NoSQL For Dummies", John Wiley & Sons, ISBN-1118905628
5. Kevin Roebuck, "Storing and Managing Big Data - NoSQL, HADOOP and More", Emereopty Limited, ISBN: 1743045743, 9781743045749
6. Joy A. Kreibich, "Using SQLite", O'REILLY, ISBN: 13:978-93-5110-934-1
7. Ivan Bayross, "SQL, PL/SQL the Programming Language of Oracle", BPB Publications ISBN: 9788176569644, 9788176569644
8. Seema Acharya, "Demystifying NoSQL", Wiley Publications, ISBN: 9788126579969

**e-Books :**

1. SQL and Relational Theory
  - a. (How to Write Accurate SQL code), C.J. Date, O'REILLY Publication
2. SQL A Beginner's Guide, Andy Oppel, Robert Sheldon, McGraw Hill Publication

**MOOCs Courses Links:**

- <http://www.nptelvideos.com/lecture.php?id=6518>

**@ The CO-PO Mapping Matrix**

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
<b>CO1</b>	2	2	3	1	-	-	-	1	-	-	-	3
<b>CO2</b>	-	2	3	-	-	2	-	-	-	-	-	3
<b>CO3</b>	-	2	3	-	1	-	-	-	-	-	-	3
<b>CO4</b>	2	2	2	2	-	-	-	-	-	1	-	3
<b>CO5</b>	-	2	3	-	-	-	-	-	-	-	1	3
<b>CO6</b>	2	2	-	-	-	-	-	1	-	2	-	1

Teaching Scheme:

Theory: 03 Hours/Week

Credit: 03

Examination Scheme:

Mid-Sem (TH) : 30 Marks

End-Sem (TH): 70 Marks

**Prerequisites Courses:** Discrete Mathematics (210241)**Companion Course:** --**Course Objectives:**

- To introduce the students to basics of Theory of Computation
- To study abstract computing models to provide a formal connection between algorithmic problem solving and the theory of languages
- To understand Grammar, Pushdown Automata and Turing Machine for language processing and algorithm design
- To learn about the theory of computability and complexity for algorithm design

**Course Outcomes:**

After completion of the course, learners should be able to

**CO1:** Understand formal language, translation logic, essentials of translation, alphabets, language representation and apply it to design Finite Automata and its variants

**CO2:** Construct regular expression to present regular language and understand pumping lemma for RE

**CO3:** Design Context Free Grammars and learn to simplify the grammar

**CO4:** Construct Pushdown Automaton model for the Context Free Language

**CO5:** Devise Turing Machine for the different requirements outlined by theoretical computer science

**CO6:** Analyze different classes of problems, and study concepts of NP completeness

**Course Contents****Unit I****Formal Language Theory and Finite Automata****07 Hours**

**Finite Automata (FA):** An informal picture of FA, Finite State Machine (FSM), Language accepted by FA, Definition of Regular Language.

**FA without output:** Deterministic and Nondeterministic FA (DFA and NFA), epsilon- NFA and inter-conversion. Minimization of DFAs.

**FA with output:** Moore and Mealy machines -Definition, models, inter-conversion.

**#Exemplar/Case Studies**

FSM for vending machine, spell checker

**\*Mapping of Course Outcomes for Unit I**

CO1

**Unit II****Regular Expressions (RE)****07 Hours**

Introduction, Operators of RE, Precedence of operators, Algebraic laws for RE, Language to Regular Expressions, Equivalence of two REs. **Conversions:** RE to NFA, DFA, DFA to RE using Arden's theorem, Pumping Lemma for Regular languages, Closure and Decision properties of Regular languages. Myhill-Nerode theorem.

**#Exemplar/Case Studies**

RE in text search and replace

<b>*Mapping of Course Outcomes for Unit II</b>	CO2	
<b>Unit III</b>	<b>Context Free Grammar (CFG) and Context Free Language(CFL)</b>	<b>07 Hours</b>
Basic Elements of Grammar, Formal Definition of Context Free Grammar, Sentential form, Derivation and Derivation Tree/ Parse Tree, Context Free Language (CFL), Ambiguous Grammar, writing grammar for language. <b>Simplification of CFG:</b> Eliminating $\epsilon$ -productions, unit productions, useless production, and useless symbols. <b>Normal Forms:</b> Chomsky Normal Form, Greibach Normal Form, Pumping Lemma for CFG, Closure properties of CFL, Decision properties of CFL, Chomsky Hierarchy, Cock-Younger-Kasami Algorithm.		
<b>#Exemplar/Case Studies</b>	Parser, CFG for Palindromes, Parenthesis Match	
<b>*Mapping of Course Outcomes for Unit III</b>	CO3	
<b>Unit IV</b>	<b>Pushdown Automata (PDA)</b>	<b>07 Hours</b>
Introduction, Formal definition of PDA, Equivalence of Acceptance by Final State and Empty stack, Non-deterministic PDA (NPDA), PDA and Context Free Language, Equivalence of PDA and CFG, PDA vs CFLs. Deterministic CFLs.		
<b>#Exemplar/Case Studies</b>	Parsing and PDA: Top-Down Parsing, Bottom-up Parsing simulation showing use of PDA	
<b>*Mapping of Course Outcomes for Unit IV</b>	CO4	
<b>Unit V</b>	<b>Turing Machines (TM)</b>	<b>07 Hours</b>
Turing Machine Model, Formal definition of Turing Machines, Language Acceptability by Turing Machines, Design of TM, Description of TM, Techniques for TM Construction, Computing function with Turing Machine, Variants of Turing Machines, Halting Problem of TM, Halting vs Looping, A Turing-unrecognizable language, Reducibility, Recursion Theorem. The Model of Linear Bounded Automata.		
<b>#Exemplar/Case Studies</b>	Algorithms using Turing Machine	
<b>*Mapping of Course Outcomes for Unit V</b>	CO5	
<b>Unit VI</b>	<b>Computability and Complexity Theory</b>	<b>07 Hours</b>
<b>Computability Theory:</b> Decidable Problems and Un-decidable Problems, Church-Turing Thesis. <b>Reducibility:</b> Undecidable Problems that is recursively enumerable, A Simple Un-decidable problem. <b>Complexity Classes:</b> Time and Space Measures, The Class P, Examples of problems in P, The Class NP, Examples of problems in NP, P Problem Versus NP Problem, NP-completeness and NP-hard Problems.		
<b>#Exemplar/Case Studies</b>	Traveling salesman problem, Post Correspondence Problem (PCP)	
<b>*Mapping of Course Outcomes for Unit VI</b>	CO6	
<b>Learning Resources</b>		

**Text Books:**

1. John E. Hopcroft, Rajeev Motwani, Jeffrey D.Ullman, "Introduction to Automata Theory Languages and Computation", Addison-Wesley, ISBN 0-201-44124-1
2. Daniel Cohen, "Introduction to Computer Theory", Wiley & Sons, ISBN 97881265133454

**Reference Books:**

1. Sanjeev Arora and Boaz Barak, "Computational Complexity: A Modern Approach", Cambridge University Press, ISBN: 0521424267 97805214242643
2. John Martin, "Introduction to Languages and The Theory of Computation", 2nd Edition, McGrawHill Education, ISBN-13: 978-1-25-900558-9, ISBN-10: 1-25-900558-5
3. J.Carroll & D Long, "Theory of Finite Automata", Prentice Hall, ISBN 0-13-913708-45
4. Kavi Mahesh, "Theory of Computation: A Problem-Solving Approach", Wiley India, ISBN1081265331106
5. Michael Sipser, "Introduction to the Theory of Computation", Cengage Learning, ISBN-13: 97811331878137
6. Vivek Kulkarni, "Theory of Computation", Oxford University Press, ISBN 0-19-808458

**e-Books :**

- <https://cglab.ca/~michiel/TheoryOfComputation/TheoryOfComputation.pdf>
- [https://www.cs.virginia.edu/~robins/Sipser\\_2006\\_Second\\_Edition\\_Problems.pdf](https://www.cs.virginia.edu/~robins/Sipser_2006_Second_Edition_Problems.pdf)
- [http://ce.sharif.edu/courses/94-95/1/ce414-2/resources/root/Text%20Books/Automata/John%20E.%20Hopcroft,%20Rajeev%20Motwani,%20Jeffrey%20D.%20Ullman-Introduction%20to%20Automata%20Theory,%20Languages,%20and%20Computations-Prentice%20Hall%20\(2006\).pdf](http://ce.sharif.edu/courses/94-95/1/ce414-2/resources/root/Text%20Books/Automata/John%20E.%20Hopcroft,%20Rajeev%20Motwani,%20Jeffrey%20D.%20Ullman-Introduction%20to%20Automata%20Theory,%20Languages,%20and%20Computations-Prentice%20Hall%20(2006).pdf)

**MOOCs Courses Links:**

- <https://nptel.ac.in/courses/106/104/106104148/>
- <https://nptel.ac.in/courses/106/104/106104028/>

<b>@ The CO-PO Mapping Matrix</b>												
<b>CO/ PO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>
<b>CO1</b>	3	3	2	2	1	-	-	-	-	-	-	2
<b>CO2</b>	3	3	2	2	1	-	-	-	-	-	-	1
<b>CO3</b>	3	3	2	2	1	-	-	-	-	-	-	1
<b>CO4</b>	3	3	2	2	1	-	-	-	-	-	-	1
<b>CO5</b>	3	3	3	2	1	-	-	-	-	-	-	2
<b>CO6</b>	3	3	3	3	1	-	-	-	-	-	-	1

**Savitribai Phule Pune University****Third Year of Computer Engineering (2019 Course)****310243: Systems Programming and Operating System** Home**Teaching Scheme:****Theory: 03****Hours/Week****Credit: 03****Examination Scheme:****Mid-Sem (TH) : 30 Marks****End-Sem (TH): 70 Marks**

**Prerequisites Courses:** Programming and Problem Solving (110005), Data Structures and Algorithms (210252), Principles of Programming Languages (210255), Microprocessor (210254)

**Companion Course:** Laboratory Practice I (310248)

**Course Objectives:**

- To get acquainted with the basics of System Programming
- To acquire knowledge of data structures used in the design of System Software
- To be familiar with the format of object modules, the functions of linking, relocation, and loading
- To comprehend the structures and functions of Operating Systems and process management.
- To deal with concurrency and deadlock in the Operating System
- To learn and understand memory management of Operating System

**Course Outcomes:**

On completion of the course, learners should be able to

**CO1:** Analyze and synthesize basic System Software and its functionality.

**CO2:** Identify suitable data structures and Design & Implement various System Software

**CO3:** Compare different loading schemes and analyze the performance of linker and loader

**CO4:** Implement and Analyze the performance of process scheduling algorithms

**CO5:** Identify the mechanism to deal with deadlock and concurrency issues

**CO6:** Demonstrate memory organization and memory management policies

**Course Contents**

<b>Unit I</b>	<b>Introduction</b>	<b>08 Hours</b>
	Introduction to Systems Programming, Need of Systems Programming, Software Hierarchy, Types of software: system software and application software, Machine structure.	
	<b>Evolution of components of Systems Programming:</b> Text Editors, Assembler, Macros, Compiler, Interpreter, Loader, Linker, Debugger, Device Drivers, Operating System. <b>Elements of Assembly Language Programming:</b> Assembly Language statements, Benefits of Assembly Language, A simple Assembly scheme, Pass Structure of Assembler.	
	<b>Design of two pass Assembler:</b> Processing of declaration statements, Assembler Directives and imperative statements, Advanced Assembler Directives, Intermediate code forms, Pass I and Pass II of two pass Assembler.	
<b>#Exemplar/Case Studies</b>	Study of Debugging tools like GDB	
<b>*Mapping of Course Outcomes for Unit I</b>	CO1, CO2, CO3	
<b>Unit II</b>	<b>Macro Processor and Compilers</b>	<b>06 Hours</b>
	Introduction, <b>Features of a Macro facility:</b> Macro instruction arguments, Conditional Macro expansion, Macro calls within Macros, Macro instructions, Defining Macro, Design of two pass Macro processor, Concept of single pass Macro processor.	
	<b>Introduction to Compilers:</b> Phases of Compiler with one example, Comparison of Compiler and Interpreter.	

#Exemplar/Case Studies	GNU M4 Macro Processor	
*Mapping of Course Outcomes for Unit II	CO1, CO2, CO3	
Unit III	Linkers and Loaders	07 Hours
Introduction, <b>Loader schemes</b> : Compile and Go, General Loader Scheme, Absolute Loaders, Subroutine Linkages, Relocating Loaders, Direct linking Loaders, Overlay structure, Design of an Absolute Loader, Design of Direct linking Loader, Self-relocating programs, Static and Dynamic linking.		
#Exemplar/Case Studies	Study the concepts of Class loading in Java.	
*Mapping of Course Outcomes for Unit III	CO1, CO2, CO3	
Unit IV	Operating System (OS)	07 Hours
<b>Introduction:</b> Evolution of OS, Operating System Services, Functions of Operating System. <b>Process Management:</b> Process, Process States: 5 and 7 state model, Process control block, Threads, Thread lifecycle, Multithreading Model, Process control system calls. <b>Process Scheduling:</b> Uni-processor Scheduling, Scheduling: Preemptive, Non-preemptive, Long-term, Medium-term, Short term scheduling. <b>Scheduling Algorithms:</b> FCFS, SJF, RR, and Priority.		
#Exemplar/Case Studies	Process management in Linux /Windows/Android Readers-Writers problem	
*Mapping of Course Outcomes for Unit IV	CO4	
Unit V	Synchronization and Concurrency Control	07 Hours
<b>Concurrency:</b> Principle and issues with Concurrency, Mutual Exclusion, Hardware approach, Software approach, Semaphore, Mutex and monitor, Reader writer problem, Producer Consumer problem, Dining Philosopher problem. <b>Deadlocks:</b> Principle of Deadlock, Deadlock prevention, Deadlock avoidance, Deadlock detection, Deadlock recovery.		
#Exemplar/Case Studies	Concurrency Mechanism: Unix/Linux/Windows.	
*Mapping of Course Outcomes for Unit V	CO5	
Unit VI	Memory Management	07 Hours
<b>Introduction:</b> Memory Management concepts, Memory Management requirements. <b>Memory Partitioning:</b> Fixed Partitioning, Dynamic Partitioning, Buddy Systems Fragmentation, Paging, Segmentation, Address translation. <b>Placement Strategies:</b> First Fit, Best Fit, Next Fit and Worst Fit. <b>Virtual Memory (VM):</b> Concepts, Swapping, VM with Paging, Page Table Structure, Inverted Page Table, Translation Look aside Buffer, Page Size, VM with Segmentation, VM with Combined paging and segmentation. <b>Page Replacement Policies:</b> First In First Out (FIFO), Last Recently Used(LRU), Optimal, Thrashing.		
#Exemplar/Case Studies	Memory management in Linux /Windows/Android	

<b>*Mapping of Course Outcomes for Unit VI</b>	CO6
	<b>Learning Resources</b>

**Text Books:**

1. John Donovan, "Systems Programming", McGraw Hill, ISBN 978-0-07-460482-3
2. Dhamdhere D., "Systems Programming and Operating Systems", McGraw Hill, ISBN 0 - 07 - 463579 – 4
3. Silberschatz, Galvin, Gagne, "Operating System Principles", 9<sup>th</sup> Edition, Wiley, ISBN 978- 1-118-06333-0

**Reference Books:**

1. Leland Beck, "System Software: An Introduction to Systems Programming", Pearson
2. John R. Levine, Tony Mason, Doug Brown, "Lex & Yacc", 1st Edition, O'REILLY, ISBN 81-7366-062-X
3. Alfred V. Aho, Ravi Sethi, Jeffrey D. Ullman, "Compilers Principles, Techniques, and Tools", Addison Wesley, ISBN 981-235-885-4

**e-Books :**

- <https://www.elsevier.com/books/systems-programming/anthony/978-0-12-800729-7>
- <https://www.kobo.com/us/en/ebook/linux-system-programming-1>
- <https://www.ebooks.com/en-us/subjects/computers-operating-systems-ebooks/279/>
- <https://www.e-booksdirectory.com/details.php?ebook=9907>

**MOOCs Courses Links:**

- <https://www.udacity.com/course/introduction-to-operating-systems--ud923>
- [nptel video lecture link: https://nptel.ac.in/courses/106/105/106105214/](https://nptel.ac.in/courses/106/105/106105214/)
- <https://www.edx.org/course/computer-hardware-and-operating-systems>
- [https://onlinecourses.nptel.ac.in/noc19\\_cs50/preview](https://onlinecourses.nptel.ac.in/noc19_cs50/preview)
- <https://www.udemy.com/course/system-programming/>

**@ The CO-PO Mapping Matrix**

CO/ PO	PO1	PO2	PO 3	PO4	PO 5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>CO1</b>	2	2	2	1	-	-	-	-	-	-	-	-
<b>CO2</b>	2	2	1	2	-	-	-	-	-	-	-	-
<b>CO3</b>	2	2	1	1	-	-	-	-	-	-	-	-
<b>CO4</b>	2	1	2	1	-	-	-	-	-	-	-	1
<b>CO5</b>	2	2	1	2	-	-	-	-	-	-	-	1
<b>CO6</b>	2	1	2	1	-	-	-	-	-	-	-	1

Teaching Scheme:

Theory: **03**

Hours/Week

Credit: **03**

Examination Scheme:

Mid-Sem (TH) : **30 Marks**End-Sem (TH): **70 Marks****Prerequisites Courses:** Discrete Mathematics (210241)**Companion Course:** Computer Networks and Security Laboratory (310247)**Course Objectives:**

- To understand the fundamental concepts of networking standards, protocols and technologies
- To learn different techniques for framing, error control, flow control and routing
- To learn different layer protocols in the protocol stacks
- To understand modern network architectures with respect to design and performance
- To learn the fundamental concepts of Network Security

**Course Outcomes:**

On completion of the course, learners should be able to

**CO1:** Summarize fundamental concepts of Computer Networks, architectures, protocols and technologies**CO2:** Illustrate the working and functions of data link layer**CO3:** Analyze the working of different routing protocols and mechanisms**CO4:** Implement client-server applications using sockets**CO5:** Illustrate role of application layer with its protocols, client-server architectures**CO6:** Comprehend the basics of Network Security**Course Contents**

<b>Unit I</b>	<b>Introduction To Computer Networks</b>	<b>06 Hours</b>
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**Definition, Types of Networks:** Local area networks (LAN), Metropolitan area networks (MAN), Wide area networks (WAN), Wireless networks, Networks Software, Protocol, Design issues for the Network layers. **Network Models:** The OSI Reference Model, TCP/IP Model, Network Topologies, Types of Transmission Medium. **Network Architectures:** Client-Server, Peer To Peer, Hybrid. **Network Devices:** Bridge, Switch, Router, Gateway, Access Point. **Line Coding Schemes:** Manchester and Differential Manchester Encodings, Frequency Hopping (FHSS) and Direct Sequence Spread Spectrum (DSSS).

**#Exemplar/Case Studies**

Study of Campus wide networking.

**\*Mapping of Course Outcomes for Unit I**

CO1

<b>Unit II</b>	<b>Data Link Layer</b>	<b>08 Hours</b>
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Introduction, functions. **Design Issues:** Services to Network Layer, Framing. **ARQ strategies:** Error detection and correction, Parity Bits, Hamming Codes (11/12-bits) and CRC. **Flow Control Protocols:** Unrestricted Simplex, Stop and Wait, Sliding Window Protocol. **WAN Connectivity:** PPP and HDLC. **MAC Sub layer:** Multiple Access Protocols: Pure and Slotted ALOHA, CSMA, WDMA, CSMA/CD, CSMA/CA, Binary Exponential Back-off algorithm, Introduction to Ethernet IEEE 802.3, IEEE 802.11 a/b/g/n, IEEE 802.15 and IEEE 802.16 Standards.

**#Exemplar/Case Studies**

Demonstration of DLL protocols on Simulator

<b>*Mapping of Course Outcomes for Unit II</b>	CO2	
	<b>Unit III</b>	<b>Network Layer</b>
<b>08 Hours</b>		
<p><b>Introduction:</b> Functions of Network layer. <b>Switching Techniques:</b> Circuit switching, Message Switching, Packet Switching. <b>IP Protocol:</b> Classes of IP (Network addressing), IPv4, IPv6, Network Address Translation, Sub-netting, CIDR. <b>Network layer Protocols:</b> ARP, RARP, ICMP, IGMP. <b>Network Routing and Algorithms:</b> Static Routing, Dynamic Routing, Distance Vector Routing, Link State Routing, Path Vector. <b>Routing Protocols:</b> RIP, OSPF, BGP, MPLS. <b>Routing in MANET:</b> AODV, DSR, Mobile IP.</p>		
<b>#Exemplar/Case Studies</b>	Demonstration of Routing Protocols on simulator.	
<b>*Mapping of Course Outcomes for Unit III</b>	CO3	
<b>Unit IV</b>	<b>Transport Layer</b>	<b>07 Hours</b>
<p>Process to Process Delivery, Services, Socket Programming. <b>Elements of Transport Layer Protocols:</b> Addressing, Connection establishment, Connection release, Flow control and buffering, Multiplexing, Congestion Control. <b>Transport Layer Protocols:</b> TCP and UDP, SCTP, RTP, Congestion control and Quality of Service (QoS), Differentiated services, TCP and UDP for Wireless networks.</p>		
<b>#Exemplar/Case Studies</b>	Demonstration of Transport layer protocols on Simulator.	
<b>*Mapping of Course Outcomes for Unit IV</b>	CO4	
<b>Unit V</b>	<b>Application Layer</b>	<b>06 Hours</b>
Introduction, Web and HTTP, Web Caching, DNS, Email: SMTP, MIME, POP3, Webmail, FTP, TELNET, DHCP, SNMP.		
<b>#Exemplar/Case Studies</b>	Study of Application Layer protocols using network protocol analyzer. e.g. Wireshark	
<b>*Mapping of Course Outcomes for Unit V</b>	CO5	
<b>Unit VI</b>	<b>Security</b>	<b>07 Hours</b>
<p>Introduction, Security services, Need of Security, Key Principles of Security, Threats and Vulnerabilities, Types of Attacks, ITU-T X.800 Security Architecture for OSI, Security Policy and mechanisms, Operational Model of Network Security, Symmetric and Asymmetric Key Cryptography.</p> <p>Security in Network, Transport and Application: Introduction of IPSec, SSL, HTTPS, S/MIME, Overview of IDS and Firewalls.</p>		
<b>#Exemplar/Case Studies</b>	Study of security protocols in Network, Transport and Application Layer using network protocol analyzer. Wireshark	
<b>*Mapping of Course Outcomes for Unit VI</b>	CO6	
<b>Learning Resources</b>		
<p><b>Text Books :</b></p> <ol style="list-style-type: none"> <li>1. Fourauzan B., "Data Communications and Networking", 5<sup>th</sup> Edition, TataMcGraw-Hill, Publications, ISBN: 0-07-058408-7</li> <li>2. Andrew S. Tanenbaum, "Computer Networks", 5th Edition, Pearson India, 2012.</li> </ol>		

**Reference Books :**

1. Kurose, Ross, "Computer Networking a Top Down Approach Featuring the Internet", Pearson, ISBN-10: 0132856204
2. L. Peterson and B. Davie, "Computer Networks: A Systems Approach", 5th Edition, Morgan-Kaufmann, 2012.
3. Douglas E. Comer & M.S Narayanan, "Computer Network & Internet", Pearson Education
4. William Stallings, "Cryptography and Network Security: Principles and Practice", 4th Edition
5. Pachghare V. K., "Cryptography and Information Security", 3<sup>rd</sup> Edition, PHI,

**e-Books :**

- <https://people.cs.clemson.edu/~jmarty/courses/kurose/KuroseCh1-2.pdf>
- [http://eti2506.elimu.net/Introduction/Books/Data\\_Communications\\_and\\_Networking\\_By\\_Behrouz\\_A.Forouzan.pdf](http://eti2506.elimu.net/Introduction/Books/Data_Communications_and_Networking_By_Behrouz_A.Forouzan.pdf)
- <http://intronetworks.cs.luc.edu/current/ComputerNetworks.pdf>
- [https://www.tutorialspoint.com/data\\_communication\\_computer\\_network/data\\_communication\\_on\\_computer\\_network\\_tutorial.pdf](https://www.tutorialspoint.com/data_communication_computer_network/data_communication_on_computer_network_tutorial.pdf)

**Case Study:**

- <https://slideplayer.com/slide/6106945>
- <http://www.worldcolleges.info/sites/default/files/Cisco - Ccie Fundamental - Network Design And Case Studies.PDF>
- [http://vlabs.iitb.ac.in/vlabs-dev/labs\\_local/computer-networks/labs/explist.php](http://vlabs.iitb.ac.in/vlabs-dev/labs_local/computer-networks/labs/explist.php)

**MOOCs Courses link:**

- [nptel.ac.in/courses/106/105/106105183](http://nptel.ac.in/courses/106/105/106105183)
- [nptel.ac.in/courses/106/105/106105080](http://nptel.ac.in/courses/106/105/106105080)
- [nptel.ac.in/courses/106/105/106105081](http://nptel.ac.in/courses/106/105/106105081)
- [nptel.ac.in/courses/106/106/106106091](http://nptel.ac.in/courses/106/106/106106091)
- [nptel.ac.in/courses/106/105/106105031](http://nptel.ac.in/courses/106/105/106105031)
- <https://www.mooc-list.com/tags/computer-networking>
- <https://www.coursera.org/courses?query=computer%20network>

**@ The CO-PO Mapping Matrix**

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

**Savitribai Phule Pune University****Third Year of Computer Engineering (2019 Course)****Elective I****310245(A): Internet of Things and Embedded Systems****Teaching Scheme:****Theory: 03****Hours/Week****Credit: 03****Examination Scheme:****Mid-Sem (TH) : 30 Marks****End-Sem (TH): 70 Marks****Prerequisites Courses:** Digital Electronics and Logic Design (210245)**Companion Course:** Laboratory Practice I (310248)**Course Objectives:**

- To understand fundamentals of Internet of Things (IoT) and Embedded Systems
- To learn advances in Embedded Systems and IoT
- To learn methodologies for IoT application development
- To learn the IoT protocols, cloud platforms and security issues in IoT
- To learn real world application scenarios of IoT along with its societal and economic impact using case studies and real time examples

**Course Outcomes:**

On completion of the course, learners should be able to

**CO1:** Understand the fundamentals and need of Embedded Systems for the Internet of Things**CO2:** Apply IoT enabling technologies for developing IoT systems**CO3:** Apply design methodology for designing and implementing IoT applications**CO4:** Analyze IoT protocols for making IoT devices communication**CO5:** Design cloud based IoT systems**CO6:** Design and Develop secured IoT applications**Course Contents**

<b>Unit I</b>	<b>Introduction to Embedded Systems</b>	<b>07 Hours</b>
Definition, Characteristics of Embedded System, Real time systems, Real time tasks. <b>Processor basics:</b> General Processors in Computer Vs Embedded Processors, Microcontrollers, Microcontroller Properties, Components of Microcontrollers, System-On-Chip and its examples, Components of Embedded Systems, Introduction to embedded processor.		
<b>#Exemplar/Case Studies</b>	Installation of Real Time Operating System	
<b>*Mapping of Course Outcomes for Unit I</b>	CO1,CO2	
<b>Unit II</b>	<b>Internet of Things : Concepts</b>	<b>07 Hours</b>
<b>Introduction to Internet of Things (IoT):</b> Definition, Characteristics of IoT, Vision, Trends in Adoption of IoT, IoT Devices, IoT Devices Vs Computers, Societal Benefits of IoT, Technical Building Blocks. <b>Physical Design of IoT:</b> Things in IoT, Interoperability of IoT Devices, Sensors and Actuators, Need of Analog / Digital Conversion. <b>Logical Design of IoT:</b> IoT functional blocks, IoT enabling technologies, IoT levels and deployment templates, Applications in IoT.		
<b>#Exemplar/Case Studies</b>	Exemplary device: Raspberry Pi / Arduino: Programming: Arduino IDE/ Python, Interfacing. Other IoT Devices.	
<b>*Mapping of Course Outcomes for Unit II</b>	CO1,CO2	
<b>Unit III</b>	<b>IoT: Design Methodology</b>	<b>07 Hours</b>
<b>IoT Design Methodology:</b> Steps, Basics of IoT Networking, Networking Components, Internet		

Structure, Connectivity Technologies, IoT Communication Models and IoT Communication APIs, Sensor Networks, Four pillars of IoT: M2M, SCADA, WSN, RFID.

<b>#Exemplar/Case Studies</b>	Home Automation using IoT communication models and IoT Communication APIs.
<b>*Mapping of Course Outcomes for Unit III</b>	CO3,CO4

<b>Unit IV</b>	<b>IoT Protocols</b>	<b>07 Hours</b>
Protocol Standardization for IoT, M2M and WSN Protocols, RFID Protocol, Modbus Protocol, Zigbee Architecture. <b>IP based Protocols:</b> MQTT (Secure), 6LoWPAN, LoRa.		

<b>#Exemplar/Case Studies</b>	LoRa based Smart Irrigation System.
<b>*Mapping of Course Outcomes for Unit IV</b>	CO4,CO5

<b>Unit V</b>	<b>Cloud Platforms for IoT</b>	<b>07 Hours</b>
Software Defined Networking, Introduction to Cloud Storage Models, Communication API. <b>WAMP:</b> Auto Bahn for IoT, Xively Cloud for IoT. <b>Python Web Application Framework:</b> Django Architecture and application development with Django, Amazon Web Services for IoT, Sky Net IoT Messaging Platform, RESTful Web Service, GRPC,SOAP.		

<b>#Exemplar/Case Studies</b>	Smart parking, Forest fire detection
<b>*Mapping of Course Outcomes for Unit V</b>	CO4, CO5

<b>Unit VI</b>	<b>Security in IoT</b>	<b>07 Hours</b>
Introduction, Vulnerabilities of IoT, Security Requirements, Challenges for Secure IoT, Threat Modeling. <b>Key elements of IoT Security:</b> Identity establishment, Access control, Data and message security, Non-repudiation and availability, Security model for IoT, Challenges in designing IOT applications, Lightweight cryptography.		

<b>#Exemplar/Case Studies</b>	Home Intrusion Detection
<b>*Mapping of Course Outcomes for Unit VI</b>	CO2, CO6

### Learning Resources

#### Text Books:

1. Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A hands-on Approach", Universities Press, ISBN: 0: 0996025510, 13: 978-0996025515
2. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things: Key Applications and Protocols", 2nd Edition, Wiley Publication, ISBN: 978-1-119-99435-0

#### Reference Books:

1. Dawoud Shenouda Dawoud, Peter Dawoud, "Microcontroller and Smart Home Networks", ISBN: 9788770221566, e-ISBN: 9788770221559
2. Charles Crowell, "IoT-Internet of Things for Beginners: An Easy-to-Understand Introduction to IoT", ISBN-13 : 979-8613100194
3. David Hanes, Gonzalo Salgueiro, Robert Barton, Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", Cisco Press, ISBN-13: 978-1-58714-456-1 ISBN-10: 1-58714-456-5
4. David Etter, "IoT Security: Practical guide book", amazon kindle Page numbers, source ISBN: 1540335011.
5. Brian Russell, Drew Van Duren, "Practical Internet of Things Security", Second Edition,

Packt Publishing, ISBN: 9781788625821

6. Dr. Shriram K Vasudevan, Abhishek S Nagarajan, RMD Sundaram, "Internet of Things", Wiley publication, 2nd Edition, ISBN: 9789388991018

**e-Books :**

- <https://www.iotforall.com/ebooks/an-introduction-to-iot>
- <https://www.qorvo.com/design-hub/ebooks/internet-of-things-for-dummies>

**MOOCs Courses link**

- <https://nptel.ac.in/courses/106/105/106105166/>
- <https://www.udemy.com/course/a-complete-course-on-an-iot-system-design-and-development/>
- <https://www.coursera.org/learn/iot>
- <https://nptel.ac.in/courses/108/108/108108098/>

**@ The CO-PO Mapping Matrix**

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

Teaching Scheme:

Theory: 03

Hours/Week

Credit: 03

Examination Scheme:

Mid-Sem (TH) : 30 Marks

End-Sem (TH): 70 Marks

**Prerequisites Courses:** Computer Graphics (210244), Software Engineering (210253)**Companion Course:** Laboratory Practice I (310248)**Course Objectives:**

- To understand the importance of HCI design process in software development
- To learn fundamental aspects of designing and implementing user interfaces
- To study HCI with technical, cognitive and functional perspectives
- To acquire knowledge about variety of effective human-computer-interactions
- To co-evaluate the technology with respect to adapting changing user requirements in interacting with computer

**Course Outcomes:**

On completion of the course, learners should be able to

**CO1:** Design effective Human-Computer-Interfaces for all kinds of users**CO2:** Apply and analyze the user-interface with respect to golden rules of interface**CO3:** Analyze and evaluate the effectiveness of a user-interface design**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 ,multi-media, World wide web related environments**CO6:** Analyze and identify user models, user support, and stakeholder requirements of HCI systems**Course Contents**

Unit I	Introduction and Foundation of HCI	07 Hours
<b>Foundation:</b> Human Memory. <b>Thinking:</b> Reasoning and Problem Solving, Emotion, Individual Difference, Psychology and design of Interactive systems, The Computer-Text Entry Device, Positioning, Pointing, Display devices, Devices for virtual reality and 3D Interaction, The Interactions-Models of Interaction, Frameworks and HCI, Ergonomics, Interaction styles, Ergonomics, Elements of WIMP Interface, Interactivity, Measurable Human Factors, The context of Interaction. <b>Importance of User Interface:</b> Defining user Interface, Brief History of Human-Computer Interface, Good and Poor Design- Importance of good design.		
#Exemplar/Case Studies	Paper prototype – Design elements of GUI	
*Mapping of Course Outcomes for Unit I	CO1,CO6	
Unit II	Human Perspective in Interaction Design Process	07 Hours
<b>Know your user/client:</b> Understanding how people interact with computers, Important human characteristics in Design, Human considerations in design of Business systems, Human Interaction speeds, Performance versus Preference, Methods of gaining an understanding of users, Miller's Law.		
<b>Design Guidelines:</b> Navigating the interface, Organizing the display, Getting user's attention, Facilitating data entry. <b>Principles:</b> Determine user's skill level, Identify the tasks, Choose an		

interaction style, Natural Language, Eight Golden rules of Interface design, Prevent errors, Ensuring Human control while increasing automation. **Theories:** Design-by-level, Stages of action, Consistency, Contextual Theories, Dynamic theories.

#Exemplar/Case Studies	Registration form design.	
*Mapping of Course Outcomes for Unit II	CO1,CO2	
<b>Unit III</b>	<b>Interaction Styles and HCI in Software Process</b>	<b>07 Hours</b>

Design, Process of Interaction Design. **Interaction styles:** Command line, Menu Selection, Form fill-in, Direct Manipulation. **Graphical User Interface:** Popularity of Graphics, Concept of direct manipulation, Advantages, Disadvantages and characteristics of Graphical user interface. **Web User Interface:** Popularity and Characteristics, Merging of Graphical business systems and the Web- Characteristics of Intranet versus Internet, Web page versus application design, Principles for user interface design, Software life cycle, Usability Engineering, Iterative design and prototyping, Design Rationale.

#Exemplar/Case Studies	Comparison - GUI and Web design with a real time example.	
*Mapping of Course Outcomes for Unit III	CO1,CO3,CO5	
<b>Unit IV</b>	<b>Usability Evaluation and Universal Design</b>	<b>07 Hours</b>

**User interface design process:** Designing for People: Seven commandments, Usability Assessment in the Design process, Common Usability problems, Practical and Objective measures of Usability, Formative and Summative evaluation, Usability specifications for evaluation, Analytic methods, Model based analysis, GOMS model, Empirical methods, Field studies, Usability testing in Laboratory, Controlled experiments, Heuristic Evaluation, Cognitive Walkthrough.

**Evaluation framework:** Paradigms and techniques, DECIDE: a framework to guide evaluation, Universal design principles, Multi-modal interaction, Designing for diversity.

#Exemplar/Case Studies	GOMS model - Adding items to a cart of e-shopping website.	
*Mapping of Course Outcomes for Unit IV	CO1,CO3	
<b>Unit V</b>	<b>HCI Paradigms</b>	<b>07 Hours</b>

**Paradigms for Interaction:** Time sharing, Video display units, Programming toolkits, Personal computing, The metaphor, Direct manipulation, Hypertext, Computer-supported cooperative work, Agent based interfaces. **Ubiquitous Computing:** Sensor-based and context-aware interaction, Data Integrity versus Data immunity, Handling missing data, Data entry and fudge ability, Auditing versus Editing, Retrieval in Physical World, Retrieval in Digital world, Constrained Natural Language output, Five stage search framework, Dynamic queries and faceted search, The social aspects of search.

**Pattern Recognition:** Introduction, Examples, Role of Machine Learning, Pattern Recognition Process, Pattern Recognition in HCI.

#Exemplar/Case Studies	Interface Design- Pattern gesture recognition	
*Mapping of Course Outcomes for Unit V	CO1,CO3,CO4	
<b>Unit VI</b>	<b>HCI for Mobile and Handheld devices</b>	<b>07 Hours</b>

**Designing for Mobile and other devices:** Anatomy of a Mobile app, Mobile form factors, Handheld format apps, Tablet format apps, Mini-tablet format apps, Mobile Navigation, Content, and control idioms- browse controls, Navigation and toolbars, Drawers, Tap-to-reveal and direct manipulation, Searching, Sorting and Filtering, Welcome and help screens, Multi-touch gestures,

Inter-app integration, Android Accessibility Guidelines.

**Other devices:** Designing for kiosks, Designing for 10-foot interfaces, Designing for automotive interfaces, Designing for audible interfaces.

<b>#Exemplar/Case Studies</b>	GUI in Python Enlist and evaluate handled devices
<b>*Mapping of Course Outcomes for Unit VI</b>	CO3,CO5,CO6

### Learning Resources

#### Text Books:

1. Alan J. Dix. Janet Finlay, Russell Beale, "Human Computer Interaction", Pearson Education, 3rd Edition, 2004, ISBN 81-297-0409-9
2. Jenny Preece, Rogers, Sharp, "Interaction Design-beyond human-computer interaction", WILEY-INDIA, ISBN 81-265-0393-9
3. Ben Shneiderman, Catherine Plaisant, Maxine Cohen, Steven Jacobs, "Designing the User Interface: Strategies for Effective Human- Computer Interaction", 6<sup>th</sup> Edition, Pearson Education Limited, ISBN 987-1-292-03701-1.

#### Reference Books :

1. Alan Cooper, Robert Reiman, David Cronin, Christopher Noessel, "About Face: The Essentials of Interaction Design", 4<sup>th</sup> edition, WILEY, ISBN 978-1-118-76658-3
2. Mary Beth Rosson and John M. Carroll, "Usability Engineering: Scenario-Based Development of Human-Computer Interaction", Morgan Kaufmann Publishers, ISBN 978-1-558-60712-5
3. Wibert O. Galitz, "The Essential Guide to user Interface Design", WILEY India, ISBN: 978-1-265-0280-6
4. Jenifer Tidwell, "Designing Interfaces", O'REILLY, ISBN: 978-1-449-37970-4
5. Julie A. Jacko (Ed), "The Human-Computer Interaction Handbook", 3rd edition, CRC Press, 2012
6. Zou J., Nagy G. (2006) "Human-Computer Interaction for Complex Pattern Recognition Problems"
7. Basu M., Ho T.K. (eds) "Data Complexity in Pattern Recognition. Advanced Information and Knowledge Processing", Springer, London

#### e-Books :

- [http://www.37steps.com/data/pdf/PRIntro\\_medium.pdf](http://www.37steps.com/data/pdf/PRIntro_medium.pdf)
- [https://www.ecse.rpi.edu/~nagy/PDF\\_chrono/2005\\_Zou\\_Nagy\\_complexity\\_05.pdf](https://www.ecse.rpi.edu/~nagy/PDF_chrono/2005_Zou_Nagy_complexity_05.pdf)
- <https://www.raywenderlich.com/240-android-accessibility-tutorial-getting-started>

#### MOOCs Courses link

- <https://www.edx.org/course/human-computer-interaction-i-fundamentals-design-p>
- <https://www.edx.org/course/human-computer-interaction-ii-cognition-context-cu>

### @ The CO-PO Mapping Matrix

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

**Savitribai Phule Pune University****Third Year of Computer Engineering (2019 Course)**[Home](#)**Elective I****310245(C): Distributed Systems****Teaching Scheme:****Theory: 03****Hours/Week****Credit: 03****Examination Scheme:****Mid-Sem (TH) : 30 Marks****End-Sem (TH): 70 Marks****Prerequisites Courses:** Computer Networks and Security(310244)**Companion Course:** Laboratory Practice I (310248)**Course Objectives:**

- To learn the fundamentals of Distributed Systems
- To learn types of communication and synchronization in Distributed Systems
- To acquaint with the Distributed File Systems
- To understand consistency and replication in Distributed Systems
- To understand the fault tolerance based Distributed Systems

**Course Outcomes:**

On completion of the course, learners should be able to

**CO1:** Analyze Distributed Systems types and architectural styles**CO2:** Implement communication mechanism in Distributed Systems**CO3:** Implement the synchronization algorithms in Distributed System applications**CO4:** Develop the components of Distributed File System**CO5:** Apply replication techniques and consistency model in Distributed Systems**CO6:** Build fault tolerant Distributed Systems**Course Contents**

<b>Unit I</b>	<b>Introduction</b>	<b>07 Hours</b>
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Defining Distributed Systems, Characteristics, Middleware and Distributed Systems. **Design goals:** Supporting resource sharing, Making distribution transparent, Open, Scalable, Pitfalls. **Types of Distributed Systems:** High Performance Distributed Computing, Distributed Information Systems, Pervasive Systems. **Architectural styles:** Layered architectures, Object based architectures, Publish Subscribe architectures. **Middleware organization:** Wrappers, Interceptors, Modifiable middleware. **System architecture:** Centralized, Decentralized, Hybrid, Example architectures – Network File System, Web.

<b>#Exemplar/Case Studies</b>	Case Study of Middleware System that includes Design, Architecture and Application.
<b>*Mapping of Course Outcomes for Unit I</b>	CO1

<b>Unit II</b>	<b>Communication</b>	<b>07 Hours</b>
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**Introduction:** Layered Protocols, Types of Communication, Remote Procedural Call- Basic RPC Operation, Parameter Passing, RPC-based application support, Variations on RPC, Example: DCE RPC, Remote Method Invocation. **Message Oriented Communication:** Simple Transient Messaging with Sockets, Advanced Transient Messaging, Message Oriented Persistent Communication, Examples. **Multicast Communication:** Application Level Tree-Based Multicasting, Flooding-Based Multicasting, Gossip-Based Data Dissemination.

<b>#Exemplar/Case Studies</b>	Apache Kafka Distributed Event Streaming Platform, gRPC Open Source RPC Framework
<b>*Mapping of Course</b>	CO2

Outcomes for Unit II		
Unit III	Synchronization	07 Hours
<b>Clock Synchronization:</b> Physical Clocks, Clock Synchronization Algorithms. <b>Logical Clocks</b> – Lamport's Logical clocks, Vector Clocks. <b>Mutual Exclusion:</b> Overview, Centralized Algorithm, Distributed Algorithm, Token-Ring Algorithm, Decentralized Algorithm . <b>Election Algorithms:</b> Bully Algorithm, Ring Algorithm. <b>Location Systems:</b> GPS, Logical Positioning of nodes, Distributed Event Matching. <b>Gossip-Based Contribution:</b> Aggregation, A Peer-Sampling Service, Gossip-Based Overlay Construction.		
#Exemplar/Case Studies	Design Time Synchronization Mechanism in Distributed Gaming	
*Mapping of Course Outcomes for Unit III	CO3	
Unit IV	Naming and Distributed File Systems	07 Hours
Names, Identifiers, Addresses, Flat Naming, Structured Naming, Attributed Based Naming, Introduction to Distributed File Systems, File Service Architecture. <b>Case study:</b> Suns Network file System, Andrew File System.		
#Exemplar/Case Studies	Study of Google File System	
*Mapping of Course Outcomes for Unit IV	CO4	
Unit V	Consistency and Replication	07 Hours
<b>Introduction:</b> Reasons for Replication, Replication as Scaling Technique. <b>Data-Centric Consistency Models:</b> Continuous Consistency, Consistent Ordering of Operations. <b>Client-Centric Consistency Models:</b> Eventual Consistency, Monotonic Reads, Monotonic Writes, Read Your Writes, Writes Follow Reads. <b>Replica Management:</b> Finding the best server location, Content Replication and Placement, Content Distribution, Managing Replicated Objects. <b>Consistency Protocols:</b> Continuous Consistency, Sequential Consistency, Cache Coherence Protocols, Example: Caching, and Replication in the web.		
#Exemplar/Case Studies	Study of HDFS Architecture for Data Replication	
*Mapping of Course Outcomes for Unit V	CO5	
Unit VI	Fault Tolerance	07 Hours
<b>Introduction to Fault Tolerance:</b> Basic Concepts, Failure Models, Failure Masking by Redundancy. <b>Process Resilience:</b> Resilience by Process Groups, Failure Masking and Replication, Example: Paxos, Consensus in faulty systems with crash failures, some limitations on realizing Fault Tolerant tolerance, Failure Detection. <b>Reliable Client Server Communication:</b> Point to Point Communication, RPC Semantics in the Presence of Failures. <b>Reliable Group Communication:</b> Atomic multicast, Distributed commit. <b>Recovery:</b> Introduction, Check pointing, Message Logging, Recovery Oriented Computing.		
#Exemplar/Case Studies	Study of any Open Source Tool for Building Fault-Tolerant System such as Circuit Breaker/Nginx/HaProxy/Akka	
*Mapping of Course	CO6	

Outcomes for Unit VI	Learning Resources
<b>Text Books:</b>	
<ol style="list-style-type: none"> <li>1. Maarten van Steen, Andrew S. Tanenbaum, "Distributed System", Third edition, version 3</li> <li>2. George Coulouris, Jean Dollimore, Tim Kindberg, "Distributed Systems Concepts and Design", Fifth edition</li> </ol>	
<b>Reference Books:</b>	
<ol style="list-style-type: none"> <li>1. Christian Cachin, Rachid Guerraoui, Luís Rodrigues, "Introduction to Reliable and Secure Distributed Programming", Springer; 2nd ed. 2011 edition</li> <li>2. Vijay K. Garg, "Elements of Distributed Computing", Wiley</li> <li>3. Maarten Van Steen and Andrew S. Tanenbaum, "Distributed Systems", Amazon Digital Services; 3rd edition</li> </ol>	
<b>e-Books :</b>	
<ul style="list-style-type: none"> <li>• Martin Kleppmann, "Designing Data-Intensive Applications", Oreilly</li> </ul>	
<b>MOOC Courses links:</b>	
<ul style="list-style-type: none"> <li>• Prof. Rajiv Misra, Distributed System, <a href="https://nptel.ac.in/courses/106/106/106106168/#">https://nptel.ac.in/courses/106/106/106106168/#</a></li> <li>• Prof. Rajiv Misra, Cloud computing and Distributed System</li> <li>• Prof. Rajiv Misra, Distributed System, <a href="https://nptel.ac.in/courses/106/104/106104182/">https://nptel.ac.in/courses/106/104/106104182/</a></li> </ul>	

### @The CO-PO Mapping Matrix

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

**Savitribai Phule Pune University****Third Year of Computer Engineering (2019 Course)****Elective I****310245(D): Software Project Management** Home**Teaching Scheme:****Theory: 03****Hours/Week****Credit: 03****Examination Scheme:****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**

<b>Unit I</b>	<b>Introduction to Software Project Management</b>	<b>07 Hours</b>
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.		
<b>#Exemplar/Case Studies</b>	Analysis of a project using PMBOK concepts	
<b>*Mapping of Course Outcomes for Unit I</b>	CO1	
<b>Unit II</b>	<b>Project Planning and Project Management Tools</b>	<b>07 Hours</b>
<b>Project Planning:</b> 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.		
<b>#Exemplar/Case Studies</b>	Create software project plan using any tool.	
<b>*Mapping of Course Outcomes for Unit II</b>	CO2	
<b>Unit III</b>	<b>Activity based Scheduling</b>	<b>07 Hours</b>
Introduction, Objectives of Activity Planning, Project Schedules. <b>Activities:</b> 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.		
<b>#Exemplar/Case Studies</b>	Apply the critical path technique to the project	
<b>*Mapping of Course Outcomes for Unit III</b>	CO3	
<b>Unit IV</b>	<b>Project Tracking and Control</b>	<b>07 Hours</b>

Introduction, Collection of Project data, Visualizing progress, Cost monitoring, Earned Value Analysis, Project tracking, Change Control, Software Configuration Management, Managing contracts, Contract Management.

<b>#Exemplar/Case Studies</b>	Analyze the effect of a major requirement change on the schedule
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<b>*Mapping of Course Outcomes for Unit IV</b>	CO4
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<b>Unit V</b>	<b>Agile Project Management</b>	<b>07 Hours</b>
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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.

<b>#Exemplar/Case Studies</b>	Analyse the same project using Agile. Create the three stages of the project.
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<b>*Mapping of Course Outcomes for Unit V</b>	CO5
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<b>Unit VI</b>	<b>Staffing in Software Projects</b>	<b>07 Hours</b>
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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.

<b>#Exemplar/Case Studies</b>	Analyse a case study for a distributed team and comment
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<b>*Mapping of Course Outcomes for Unit VI</b>	CO6
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### 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](https://onlinecourses.nptel.ac.in/noc19_cs70/preview)
- [Software Project Management By Prof. Rajib Mall & Prof. Durga Prasad Mohapatra | IIT Kharagpur](https://onlinecourses.nptel.ac.in/noc19_cs70/preview)
- 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)**  
**310246:Database Management Systems Laboratory**

<b>Teaching Scheme</b> Practical: <b>04 Hours/Week</b>	<b>Credit:02</b>	<b>Examination Scheme and Marks</b> Term work: <b>25 Marks</b> Practical: <b>25 Marks</b>
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**Companion Course:** Database Management Systems(310241)

**Course Objectives:**

- To develop Database programming skills
- To develop basic Database administration skills
- To develop skills to handle NoSQL database
- To learn, understand and execute process of software application development

**Course Outcomes:**

On completion of the course, learners will be able to

- CO1:** Design E-R Model for given requirements and convert the same into database tables
- CO2:** Design schema in appropriate normal form considering actual requirements
- CO3:** Implement SQL queries for given requirements, using different SQL concepts
- CO4:** Implement PL/SQL Code block for given requirements
- CO5:** Implement NoSQL queries using MongoDB
- CO6:** Design and develop application considering actual requirements and using database concepts

**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.

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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.

Operating System recommended :- 64-bit Open source Linux or its derivative  
 Programming tools recommended: - MYSQL/Oracle, MongoDB, ERD plus, ER Win

### **Virtual Laboratory:**

- <http://vlabs.iitb.ac.in/vlabs-dev/labs/dblab/labs/index.php>

### **Suggested List of Laboratory Experiments/Assignments**

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

Sr. No.	Group A: SQL and PL/SQL
1.	<p><b>ER Modeling and Normalization:</b>        Decide a case study related to real time application in group of 2-3 students and formulate a problem statement for application to be developed. Propose a Conceptual Design using ER features using tools like ERD plus, ER Win etc. (Identifying entities, relationships between entities, attributes, keys, cardinalities, generalization, specialization etc.) Convert the ER diagram into relational tables and normalize Relational data model.        Note: Student groups are required to continue same problem statement throughout all the assignments in order to design and develop an application as a part Mini Project. Further assignments will be useful for students to develop a backend for system. To design front end interface students should use the different concepts learnt in the other subjects also.</p>
2.	<p><b>SQL Queries:</b></p> <ol style="list-style-type: none"> <li>a. Design and Develop SQLDDL statements which demonstrate the use of SQL objects such as Table, View, Index, Sequence, Synonym, different constraints etc.</li> <li>b. Write at least 10 SQL queries on the suitable database application using SQL DML statements.        Note: Instructor will design the queries which demonstrate the use of concepts like Insert, Select, Update, Delete with operators, functions, and set operator etc.</li> </ol>
3.	<p><b>SQL Queries – all types of Join, Sub-Query and View:</b>        Write at least 10 SQL queries for suitable database application using SQL DML statements.        Note: Instructor will design the queries which demonstrate the use of concepts like all types of Join ,Sub-Query and View</p>
4.	<p><b>Unnamed PL/SQLcode block: Use of Control structure and Exception handling is mandatory.</b>        Suggested Problem statement:        Consider Tables:        1. Borrower(Roll_no, Name, Date of Issue, Name of Book, Status)        2. Fine(Roll_no, Date, Amt)       <ul style="list-style-type: none"> <li>• Accept Roll_no and Name of Book from user.</li> <li>• Check the number of days (from date of issue).</li> <li>• If days are between 15 to 30 then fine amount will be Rs 5 per day.</li> <li>• If no. of days &gt; 30, per day fine will be Rs 50 per day and for days less than 30, Rs. 5 per day.</li> </ul> </p>

5.	<ul style="list-style-type: none"> <li>After submitting the book, status will change from I to R.</li> <li>If condition of fine is true, then details will be stored into fine table.</li> <li>Also handles the exception by named exception handler or user define exception handler.</li> </ul> <p style="text-align: center;"><b>OR</b></p> <p>Write a PL/SQL code block to calculate the area of a circle for a value of radius varying from 5 to 9. Store the radius and the corresponding values of calculated area in an empty table named areas, consisting of two columns, radius and area.</p> <p>Note: Instructor will frame the problem statement for writing PL/SQL block in line with above statement.</p>
6.	<p><b>Named PL/SQL Block: PL/SQL Stored Procedure and Stored Function.</b></p> <p>Write a Stored Procedure namely proc_Grade for the categorization of student. If marks scored by students in examination is <math>\leq 1500</math> and <math>\geq 990</math> then student will be placed in distinction category if marks scored are between 989 and 900 category is first class, if marks 899 and 825 category is Higher Second Class.</p> <p>Write a PL/SQL block to use procedure created with above requirement.</p> <p>Stud_Marks(name, total_marks)      Result(Roll,Name, Class)</p> <p>Note: Instructor will frame the problem statement for writing stored procedure and Function in line with above statement.</p>
7.	<p><b>Cursors:(All types: Implicit, Explicit, Cursor FOR Loop, Parameterized Cursor)</b></p> <p>Write a PL/SQL block of code using parameterized Cursor that will merge the data available in the newly created table N_Roll Call with the data available in the table O_RollCall. If the data in the first table already exist in the second table then that data should be skipped.</p> <p>Note: Instructor will frame the problem statement for writing PL/SQL block using all types of Cursors in line with above statement.</p>
8.	<p><b>Database Trigger (All Types: Row level and Statement level triggers, Before and After Triggers).</b></p> <p>Write a database trigger on Library table. The System should keep track of the records that are being updated or deleted. The old value of updated or deleted records should be added in Library_Audit table.</p> <p>Note: Instructor will Frame the problem statement for writing PL/SQL block for all types of Triggers in line with above statement.</p>
9.	<p><b>Database Connectivity:</b></p> <p>Write a program to implement MySQL/Oracle database connectivity with any front end language to implement Database navigation operations (add, delete, edit etc.)</p>
	<b>Group B: NoSQL Databases</b>
1.	<p><b>MongoDB Queries:</b></p> <p>Design and Develop MongoDB Queries using CRUD operations. (Use CRUD operations, SAVE method, logical operators etc.).</p>
2.	<p><b>MongoDB – Aggregation and Indexing:</b></p> <p>Design and Develop MongoDB Queries using aggregation and indexing with suitable example using MongoDB.</p>
3.	<p><b>MongoDB – Map-reduces operations:</b></p> <p>Implement Map reduces operation with suitable example using MongoDB.</p>
4.	<p><b>Database Connectivity:</b></p> <p>Write a program to implement MongoDB database connectivity with any front end language to implement Database navigation operations (add, delete, edit etc.)</p>

Group C: Mini Project													
<p>1. Using the <b>database concepts covered in Group A and Group B</b>, develop an application with following details:</p> <ol style="list-style-type: none"> <li>Follow the same problem statement decided in Assignment -1 of Group A.</li> <li>Follow the Software Development Life cycle and other concepts learnt in <b>Software Engineering Course</b> throughout the implementation.</li> <li>Develop application considering: <ul style="list-style-type: none"> <li>Front End: Java/Perl/PHP/Python/Ruby/.net/any other language</li> <li>Backend : MongoDB/ MySQL/Oracle</li> </ul> </li> <li>Test and validate application using Manual/Automation testing.</li> <li>Student should develop application in group of 2-3 students and submit the Project Report which will consist of documentation related to different phases of Software Development Life Cycle: <ul style="list-style-type: none"> <li>Title of the Project, Abstract, Introduction</li> <li>Software Requirement Specification</li> <li>Conceptual Design using ER features, Relational Model in appropriate Normalize form</li> <li>Graphical User Interface, Source Code</li> <li>Testing document</li> <li>Conclusion.</li> </ul> </li> </ol> <p><b>Note:</b></p> <ul style="list-style-type: none"> <li>Instructor should maintain progress report of mini project through out the semester from project group.</li> <li>Practical examination will be on assignments given above in Group A and Group B only</li> <li>Mini Project in this course should facilitate the Project Based Learning among students</li> </ul>													

### @The CO-PO Mapping Matrix

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

**Teaching Scheme****Practical: 02 Hours/Week****Credit: 01****Examination Scheme and Marks****Term work: 25 Marks****Oral: 25 Marks****Companion Course:** Computer Network and Security(310244)**Course Objectives:**

- To learn computer network hardware and software components
- To learn computer network topologies and types of network
- To develop an understanding of various protocols, modern technologies and applications
- To learn modern tools for network traffic analysis
- To learn network programming

**Course Outcomes:**

On completion of the course, learners will be able to

**CO1:** Analyze the requirements of network types, topology and transmission media

**CO2:** Demonstrate error control, flow control techniques and protocols and analyze them

**CO3:** Demonstrate the subnet formation with IP allocation mechanism and apply various routing algorithms

**CO4:** Develop Client-Server architectures and prototypes

**CO5:** Implement web applications and services using application layer protocols

**CO6:** Use network security services and mechanisms

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**Guidelines for Oral Examination**

Oral examination should be jointly conducted by the internal examiner and external examiner. Relevant questions may be asked at the time of evaluation to test the student's understanding of the fundamentals, effective and efficient implementations in term work. 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.

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

Programming tools recommended: - Open-Source/C/C++/JAVA

Programming tool like G++/GCC, Wireshark/Ethereal and Packet Tracer

### **Virtual Laboratory:**

- <http://vlabs.iitb.ac.in/vlab/>

### **Suggested List of Laboratory Experiments/Assignments**

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

<b>Sr. No.</b>	<b>Group A (Unit I and II): Attempt any two assignments from Sr.No. 1 to 3. Assignments 4 and 5 are compulsory.</b>
1.	Setup a wired LAN using Layer 2 Switch. It includes preparation of cable, testing of cable using line tester, configuration machine using IP addresses, testing using PING utility and demonstrating the PING packets captured traces using Wireshark Packet Analyzer Tool.
2.	Demonstrate the different types of topologies and types of transmission media by using a packet tracer tool.
3.	Setup a WAN which contains wired as well as wireless LAN by using a packet tracer tool. Demonstrate transfer of a packet from LAN 1 (wired LAN) to LAN2 (Wireless LAN).
4.	Write a program for error detection and correction for 7/8 bits ASCII codes using Hamming Codes or CRC.
5.	Write a program to simulate Go back N and Selective Repeat Modes of Sliding Window Protocol in Peer-to-Peer mode.
	<b>Group B (Unit III and IV)</b>
6.	Write a program to demonstrate Sub-netting and find subnet masks.
7.	Write a program to implement link state /Distance vector routing protocol to find suitable path for transmission.
8.	Use packet Tracer tool for configuration of 3 router network using one of the following protocol RIP/OSPF/BGP.
9.	Write a program using TCP socket for wired network for following a. Say Hello to Each other b. File transfer c. Calculator
10.	Write a program using UDP Sockets to enable file transfer (Script, Text, Audio and Video one file each) between two machines.
	<b>Group C (Unit V and VI): Assignment Sr. No. 11 is Compulsory and attempt any four from Assignments Sr. No 12 to 17.</b>
11.	Write a program for DNS lookup. Given an IP address as input, it should return URL and vice-versa.
12.	Installing and configure DHCP server and write a program to install the software on remote machine.

13.	Capture packets using Wireshark, write the exact packet capture filter expressions to accomplish the following and save the output in file: <ol style="list-style-type: none"> <li>1. Capture all TCP traffic to/from Facebook, during the time when you log in to your Facebook account</li> <li>2. Capture all HTTP traffic to/from Facebook, when you log in to your Facebook account</li> <li>3. Write a DISPLAY filter expression to count all TCP packets (captured under item #1) that have the flags SYN, PSH, and RST set. Show the fraction of packets that had each flag set.</li> <li>4. Count how many TCP packets you received from / sent to Face book, and how many of each were also HTTP packets.</li> </ol>											
14.	Study and Analyze the performance of HTTP, HTTPS and FTP protocol using Packet tracer tool.											
15.	To study the SSL protocol by capturing the packets using Wireshark tool while visiting any SSL secured website (banking, e-commerce etc.).											
16.	Illustrate the steps for implementation of S/MIME email security through Microsoft® Office Outlook.											
17.	To study the IPsec (ESP and AH) protocol by capturing the packets using Wireshark tool.											

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<b>CO6</b>	-	1	3	1	1	-	1	-	2	-	-	1



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

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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**

<b>Sr. No.</b>	<b>Group A (Any Two Assignments from Sr. No. 1 to 3)</b>
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 write an application program to test it. (Java Native Interface / Use VB or VC++)
<b>Group B(Any Two Assignments from Sr. No. 4 to 7)</b>	
4.	Write a program to solve Classical Problems of Synchronization using Mutex and 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**

	<b>Suggested List of Laboratory Experiments/Assignments</b> <b>(Any Two assignments from each elective subject are compulsory and Instructor will take care that all the assignments should be covered among different batch students)</b>
<b>Internet of Things and Embedded Systems</b>	
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.
<b>Human Computer Interface</b>	
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.
<b>Distributed System</b>	
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) Lamport's clock.
<b>Software Project Management</b>	
1.	<b>Create Project Plan</b> <ul style="list-style-type: none"> <li>▪ Specify project name and start (or finish) date.</li> <li>▪ Identify and define project tasks.</li> <li>▪ Define duration for each project task.</li> <li>▪ Define milestones in the plan</li> <li>▪ Define dependency between tasks</li> <li>▪ Define project calendar.</li> <li>▪ Define project resources and specify resource type</li> <li>▪ Assign resources against each task and baseline the project plan</li> </ul>

2.	<p><b>Execute and Monitor Project Plan</b></p> <ul style="list-style-type: none"> <li>▪ Update % Complete with current task status.</li> <li>▪ Review the status of each task.</li> <li>▪ Compare Planned vs Actual Status</li> <li>▪ Review the status of Critical Path</li> <li>▪ Review resources assignation status</li> </ul>
3.	<p><b>Generate Dashboard and Reports</b></p> <ul style="list-style-type: none"> <li>• <b>Dashboard</b> <ul style="list-style-type: none"> <li>◦ Project Overview</li> <li>◦ Cost Overview</li> <li>◦ Upcoming Tasks</li> </ul> </li> <li>• <b>Resource Reports</b> <ul style="list-style-type: none"> <li>◦ Over-allocated Resources</li> <li>◦ Resource Overview</li> </ul> </li> <li>• <b>Cost Reports</b> <ul style="list-style-type: none"> <li>◦ Earned Value Report</li> <li>◦ Resource Cost Overview</li> <li>◦ Task Cost Overview</li> </ul> </li> <li>• <b>Progress Reports</b> <ul style="list-style-type: none"> <li>◦ Critical Tasks</li> <li>◦ Milestone Report</li> <li>◦ Slipping Tasks</li> </ul> </li> </ul>

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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

<b>Teaching Scheme</b>	<b>Credit: 01</b>	<b>Examination Scheme and Marks</b>
<b>Tutorial: 01 Hour/Week</b>		<b>Term Work: 50 Marks</b>

**Course Objectives:**

- To explore the basic principles of communication (verbal and non-verbal) and active, empathetic listening, speaking and writing techniques
- To explore the latest technologies
- To enhance the communication skills
- To develop problem analysis skills

**Course Outcomes:**

On completion of the course, learners will be able to

**CO1:** Analyze a latest topic of professional interest

**CO2:** Enhance technical writing skills

**CO3:** Identify an engineering problem, analyze it and propose a work plan to solve it

**CO4:** Communicate with professional technical presentation skills

**Guidelines**

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

**Guidelines for Assessment**

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

**Recommended Format of the Seminar Report**

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

**Reference Books :**

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

**@The CO-PO Mapping Matrix**

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

**Savitribai Phule Pune University**  
**Third Year of Engineering (2019 Course)**  
**310250: Audit Course 5**



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"> <li>• Lectures/ Guest Lectures</li> <li>• Visits (Social/Field) and reports</li> <li>• Demonstrations or presentations</li> </ul>	<ul style="list-style-type: none"> <li>• Surveys</li> <li>• Mini-Project</li> <li>• Hands on experience on focused topic</li> </ul>
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**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
<b>310250(A)</b>	Cyber Security
<b>310250(B)</b>	Professional Ethics and Etiquette
<b>310250(C)</b>	Learn New Skills -Full Stack Developer
<b>310250(D)</b>	Engineering Economics
<b>310250(E)</b>	Foreign Language (one of Japanese/ Spanish/ French/ German). Course contents for <b>Japanese (Module 3)</b> are provided. For other languages institute may design suitably.

Note: It is permitted to opt one of the audit courses listed at SPPU website too, if not opted earlier.

<http://collegecirculars.unipune.ac.in/sites/documents/Syllabus%202017/Forms/AllItems.aspx>  
[http://www.unipune.ac.in/university\\_files/syllabi.htm](http://www.unipune.ac.in/university_files/syllabi.htm)

**Prerequisites:** Computer Network and Security (310244)

### Course Objectives:

- To motivate students for understanding the various scenarios of cybercrimes
- To increase awareness about the cybercrimes and ways to be more secure in online activities
- To learn about various methods and tools used in cybercrimes
- To analyze the system for various vulnerabilities

**Course Outcomes :** On completion of the course, learners will be able to

**CO 1:** Understand and classify various cybercrimes

**CO 2:** Understand how criminals plan for the cybercrimes

**CO 3:** Apply tools and methods used in cybercrime

**CO 4:** Analyze the examples of few case studies of cybercrimes

### Course Contents

- Introduction to Cybercrime:** Introduction, Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, Cybercriminals, Classifications of Cybercrimes, Cybercrime: The Legal Perspectives, Cybercrimes: An Indian Perspective.
- Cyber offenses: How Criminals Plan Them:** Introduction, How Criminals Plan the Attacks, Social Engineering, Cyber stalking, Cyber cafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector, Cloud Computing.
- Tools and Methods Used in Cybercrime :** Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Key loggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks (Expected to cover the introduction to all these terms).
- Cybercrime: Illustrations, Examples and Mini-Cases :** Introduction, Real-Life Examples, Mini-Cases, Illustrations of Financial Frauds in Cyber Domain, Digital Signature-Related Crime Scenarios, Digital Forensics Case Illustrations, Online Scams.

### Text Books :

1. Nina Godbole, Sunit Belapure , “Cyber Security- Understanding Cyber Crimes”, Computer Forensics and Legal Perspectives, Wiley India Pvt. Ltd, ISBN- 978-81-265-2179-1
2. William Stallings, “Computer Security: Principles and Practices”, Pearson 6<sup>th</sup>Ed, ISBN 978-0-13-335469-0

### Reference Books :

1. Berouz Forouzan, “Cryptography and Network Security”, TMH, 2 edition, ISBN -978-00-707-0208-0. 5.
2. Mark Merkow, “Information Security-Principles and Practices”, Pearson Ed., ISBN- 978-81-317-1288-7
3. CK Shyamala et el., “Cryptography and Security”, Wiley India Pvt. Ltd, ISBN-978-81-265-2285-9

### @The CO-PO Mapping Matrix

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

**Savitribai Phule Pune University**  
**Third Year of Engineering (2019 Course)**  
**Audit Course 5**  
**310250(B): Professional Ethics and Etiquettes**



**Prerequisites:** Business Communication Skill

**Course Objectives:**

- To learn importance of ethics and the rules of good behavior for today's most common social and business situations.
- To acquire basic knowledge of ethics to make informed ethical decisions when confronted with problems in the working environment.
- To develop an understanding towards business etiquettes and the proper etiquette practices for different business scenarios.
- To learn the etiquette requirements for meetings, entertaining, telephone, email and Internet business interaction scenario.

**Course Outcomes:**

On completion of the course, learners will be able to

**CO1:** Summarize the principles of proper courtesy as they are practiced in the workplace.

**CO2:** Apply proper courtesy in different professional situations.

**CO3:** Practice and apply appropriate etiquettes in the working environment and day to day life.

**CO4:** Build proper practices personal and business communications of Ethics and Etiquettes.

**Course Contents**

1. **Introduction to Ethics:** Basics, Difference Between Morals, Ethics, and Laws, Engineering Ethics: Purpose of Engineering Ethics-Professional and Professionalism, Professional Roles to be played by an Engineer, Uses of Ethical Theories, Professional Ethics, Development of Ethics.
2. **Professional Ethics:** IT Professional Ethics, Ethics in the Business World, Corporate Social Responsibility, Improving Corporate Ethics, Creating an Ethical Work Environment, Including Ethical Considerations in Decision Making, Ethics in Information Technology, Common Ethical issues for IT Users, Supporting the Ethical Practices of IT users.
3. **Business Etiquette:** ABC's of Etiquette, Developing a Culture of Excellence, The Role of Good Manners in Business, Enduring Words Making Introductions and Greeting People: Greeting Components, The Protocol of Shaking Hands, Introductions, Introductory Scenarios, Addressing Individuals Meeting and Board Room Protocol: Guidelines for Planning a Meeting, Guidelines for Attending a Meeting.
4. **Professional Etiquette:** Etiquette at Dining, Involuntary Awkward Actions, How to Network, Networking Etiquette, Public Relations Office(PRO)'s Etiquettes, Technology Etiquette : Phone Etiquette, Email Etiquette, Social Media Etiquette, Video Conferencing Etiquette, interview Etiquette, Dressing Etiquettes : for interview, offices and social functions.

**References Books:**

1. Ghillyer, "Business Ethics Now", 3rd Edition, McGraw-Hill.
2. George Reynolds, "Ethics in information Technology", Cengage Learning, ISBN- 10:1285197151.
3. Charles E Harris, Micheal J. Rabins, "Engineering Ethics", Cengage Learning, ISBN- 13:978-1133934684,4th Edition.

**@The CO-PO Mapping Matrix**

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

**Savitribai Phule Pune University**  
**Third Year of Engineering (2019 Course)**  
**Audit Course 5**  
**310250(C): Learn New Skills- Full Stack Developer**



**Prerequisites:** Programming Skills

**Course Objectives:**

- To understand the fundamental concepts in designing web based applications and applying frontend and backend technologies
- To understand the fundamental concepts in applying database techniques in application
- To progress the student towards term "industry ready engineer"

**Course Outcomes:**

On completion of the course, learners will be able to

**CO1:** Design and develop web application using frontend and backend technologies.

**CO2:** Design and develop dynamic and scalable web applications

**CO3:** Develop server side scripts

**CO4:** Design and develop projects applying various database techniques

**Course Contents**

**Full stack Developer**

1. HTML5
2. CSS3
3. Bootstrap
4. Vanilla JS (ES6+)
5. Flask or Django
6. Wagtail CMS
7. Node.js
8. MySQL
9. jQuery

**Team Projects:** Design and develop an e-commerce a dynamic, scalable and responsive web application. (Sample Project similar problem statements and be formulated).

**Reference Books:**

1. Laura Lemay, Rafe Colburn and Jennifer Kyrnin, "Mastering HTML, CSS & Javascript Web Publishing", SAMS, BPB Publications
2. DT Editorial Services " HTML 5 Black Book (Covers CSS3, JavaScript, XML, XHTML, AJAX, PHP, jQuery)" 2Ed , Dreamtech Press.

**Note:** This is sample contents for Software Development Using Agility Approach, however the course instructor may design suitable course giving opportunity to the students for learning new skills.

**@The CO-PO Mapping Matrix**

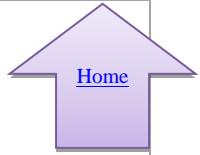
<b>CO\ PO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>
<b>CO1</b>	3	3	3	3	3	1	1	1	1	1	1	1
<b>CO2</b>	3	3	3	3	3	1	1	1	1	1	1	1
<b>CO3</b>	3	3	3	3	3	1	1	1	1	1	1	1
<b>CO4</b>	3	3	3	3	3	1	1	1	1	1	1	1

**Savitribai Phule Pune University**  
**Third Year of Engineering (2019 Course)**  
**Audit Course 5**  
**310250(D): Engineering Economics**

Engineering economics is one of the most practical subject matters in the engineering curriculum, but it is an always challenging, ever-changing discipline. Engineers are planners and builders. They are also problem solvers, manager, decision makers. Engineering economics touches of these activities.

**Course Objectives:**

- To understand engineering economics and money management
- To understand financial project analysis
- To estimate project cost and apply for business
- To understand making financial decisions when acting as team member or manager in the engineering project



**Course Outcomes:**

On completion of the course, learners will be able to

**CO1:** Understand economics, the cost money and management in engineering

**CO2:** Analyze business economics and engineering assets evaluation

**CO3:** Evaluate project cost and its elements for business

**CO4:** Develop financial statements and make business decisions

**Course Contents**

1. **Understanding money and its management:** Engineering Economic Decisions, Time value of money, Money management, Equivalence calculations.
2. **Evaluating business and engineering assets:** Present worth analysis, Annual equivalence Analysis, Rate of Return Analysis, Benefit Cost Analysis.
3. **Development project cash flow:** Accounting of Income Taxes, Project cash flow Analysis, Handling Project Uncertainty.
4. **Special topics in Engineering Economics:** Replacement decisions, understanding financial statements.

**Reference Books :**

1. Chan S Park, "Fundamentals of Engineering Economics", Pearson, ISBN-13: 9780134870076
2. James Riggs, "Engineering Economics", Tata McGraw-Hill, ISBN – 13: 9780070586703

**@The CO-PO Mapping Matrix**

CO\ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
<b>CO1</b>	1	1	1	-	-	-	-	-	2	2	3	1
<b>CO2</b>	1	1	1	-	-	-	-	-	2	2	3	1
<b>CO3</b>	1	1	1	-	-	-	-	-	2	2	3	1
<b>CO4</b>	1	1	1	-	-	-	-	-	2	2	3	1

**Savitribai Phule Pune University**  
**Third Year of Engineering (2019 Course)**  
**Audit Course 5**  
**310250(E): Foreign Language ( Japanese )-Module 3**



**Prerequisites:** We recommend that candidates should have previously completed AC3-V(210251) and AC4-V (210260)

**Course Objectives:**

- To open up more doors and job opportunities
- To introduce to Japanese society, culture and entertainment

**Course Outcomes:**

On completion of the course, learners will be able to

**CO1:** Apply language to communicate confidently and clearly in the Japanese language

**CO2:** Understand and use Japanese script to read and write

**CO3:** Apply knowledge for next advance level reading, writing and listening skills

**CO4:** Develop interest to pursue further study, work and leisure

**Course Contents**

1. The Kanji: Brief Historical Outline, Introduction to Kanji, From Pictures to characters
2. Read and Write 58 Kanji Characters, talk about yourself/family/others, things, time, events, and activities-in the present, future, and past tense; shop at stores and order food at restaurants;
3. Lessons: Karate, Park(Playground), The Grandpa's Inaka, The Sun and the Moon, My little sister, Rice Fields, My Teacher, People who Exit and People who Enter.

**Reference Books :**

1. Japanese Kanji and Kana, "A complete guide to the Japanese writing system", Wolfgang Hadamitzky & Mark Spahn, Tuttle Publishing, Third edition ISBN: 978-1-4629-1018-2(eBook)
2. Banno, Eri, Yoko Ikeda, et al. Genki I, "An Integrated Course in Elementary Japanese", 2nd ed. Japan Times/Tsai Fong Books, 2011. ISBN: 9784789014403.
3. Anna Sato and Eriko Sato, "My First Japanese Kanji Book, Learning kanji the fun and easy way", TUTTLE PUBLISHING, First Edition ISBN: 978-1-4629-1369-5 (eBook)

**@The CO-PO Mapping Matrix**

<b>CO\ PO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>
<b>CO1</b>	-	-	-	-	-	-	-	-	1	3	1	1
<b>CO2</b>	-	-	-	-	1	-	-	-	-	3	1	1
<b>CO3</b>	-	-	-	-	1	-	-	-	-	3	2	2
<b>CO4</b>	-	-	-	-	-	-	-	-	-	1	-	1