Curriculum for

Third Year of Artificial Intelligence and Data Science (2019 Course)
(With effect from 2022-23)

http://unipune.ac.in/university_files/syllabi.htm

Faculty of Science and Technology
Savitribai Phule Pune University Maharashtra, India
Third Year of Artificial Intelligence and Data Science (2019 Course) (With effect from 2022-23)

Prologue

It is with great pleasure and honor that I share the syllabi for Third Year of Artificial Intelligence and Data Science (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 Artificial Intelligence and Data Science Curriculum 2019:

2. [http://collegecirculars.unipune.ac.in/sites/documents/Syllabus%202019/First%20Year%20Engineering%202020%20Patt.Syllabus_05.072019.pdf](http://collegecirculars.unipune.ac.in/sites/documents/Syllabus%202019/First%20Year%20Engineering%202020%20Patt.Syllabus_05.072019.pdf)
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<td>104</td>
</tr>
</tbody>
</table>
## Program Outcomes (POs)

Learners are expected to know and be able to:

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

## Program Specific Outcomes (PSO)

A graduate of the Artificial Intelligence and Data Science Program will demonstrate:

<table>
<thead>
<tr>
<th>PSO</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSO1</td>
<td><strong>Professional Skills</strong> The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, multimedia, web design, networking, artificial intelligence and data science for efficient design of computer-based systems of varying complexities.</td>
</tr>
<tr>
<td>PSO2</td>
<td><strong>Problem-Solving Skills</strong> 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.</td>
</tr>
<tr>
<td>PSO3</td>
<td><strong>Successful Career and Entrepreneurship</strong> 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.</td>
</tr>
<tr>
<td>Course Code</td>
<td>Course Name</td>
</tr>
<tr>
<td>-------------</td>
<td>--------------------------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>310241</td>
<td>Data Base Management System</td>
</tr>
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<td>310252</td>
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<td>310253</td>
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<td>Elective I</td>
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<tr>
<td>317523</td>
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<tr>
<td>317527</td>
<td>Environmental Studies</td>
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<tr>
<td></td>
<td>Total</td>
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</table>

** Elective-I Options

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>317522 (A)</td>
<td>Embedded Systems &amp; Security</td>
</tr>
<tr>
<td>314445 (C)</td>
<td>Design Thinking</td>
</tr>
<tr>
<td>317522 (B)</td>
<td>Pattern Recognition</td>
</tr>
<tr>
<td>310245 (B)</td>
<td>Human Computer Interface</td>
</tr>
</tbody>
</table>

Audit Course 5 Options

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>317528 (A)</td>
<td>Emotional Intelligence</td>
</tr>
<tr>
<td>317528 (B)</td>
<td>Industrial Safety And Environment Consciousness</td>
</tr>
<tr>
<td>317528 (C)</td>
<td>3D Printing</td>
</tr>
<tr>
<td>317528 (D)</td>
<td>Foreign Language</td>
</tr>
<tr>
<td>317528 (E)</td>
<td>MOOC- Learn New Skills</td>
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</table>

Software Laboratory I (Assignments from) Data Base Management System and Artificial Intelligence
## Curriculum for Third Year of Artificial Intelligence and Data Science (2019 Course)

### Semester-VI

<table>
<thead>
<tr>
<th>Course Code</th>
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<th>Teaching Scheme ##(Hours/Week)</th>
<th>Examination Scheme and Marks</th>
<th>Credit Scheme</th>
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<tr>
<td>317529</td>
<td>Data Science</td>
<td>04 - -</td>
<td>30 70 - - - - 100 03 - - 03</td>
<td></td>
</tr>
<tr>
<td>317530</td>
<td>Cyber security</td>
<td>04 - -</td>
<td>30 70 - - - - 100 03 - - 03</td>
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<tr>
<td>317531</td>
<td>Artificial Neural Network</td>
<td>04 - -</td>
<td>30 70 - - - - 100 03 - - 03</td>
<td></td>
</tr>
<tr>
<td>**</td>
<td>Elective II</td>
<td>04 - -</td>
<td>30 70 - - - - 100 03 - - 03</td>
<td></td>
</tr>
<tr>
<td>317533</td>
<td>Software Laboratory II</td>
<td>- 04 -</td>
<td>- - 25 25 - 50 - 02 - 02</td>
<td></td>
</tr>
<tr>
<td>317534</td>
<td>Software Laboratory III</td>
<td>- 04 -</td>
<td>- - 50 25 - 75 - 02 - 02</td>
<td></td>
</tr>
<tr>
<td>317535</td>
<td>Internship**</td>
<td>- - -</td>
<td>- - 50 - 50 100 - 04 - 04</td>
<td></td>
</tr>
<tr>
<td>317536</td>
<td>Mini Project (CS and Elective-II)</td>
<td>- 02 -</td>
<td>- 50 - 25 75 - 01 - 01</td>
<td></td>
</tr>
<tr>
<td>**</td>
<td>Total</td>
<td>16 10 -</td>
<td>120 280 175 50 75 700 12 09 - 21</td>
<td></td>
</tr>
</tbody>
</table>

### Elective-II Options

- 317532(A) Robotics and Automation
- 317532(B) Natural Language Processing
- 310254(C) Cloud Computing
- 310254(D) Software Modeling and Architecture
- 317537(A) Digital and Social Media Marketing
- 317537(B) Sustainable Energy Systems
- 317537(C) Leadership and Personality Development
- 317537(D) Foreign Language
- 317537(E) MOOC - Learn New Skills

### Software Laboratory II (Assignments from)

- Artificial Neural Network

### Software Laboratory III (Assignments from)

- Data Science

### Mini Project (Assignments from)

- Cyber Security 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.**

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Savitribai Phule Pune University

Third Year of Artificial Intelligence and Data Science (2019 Course)

(With effect from Academic Year 2022-23)
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. These Program Outcomes (POs) 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 justify 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 so as 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[1] - Term work is continuous assessment that evaluates a student’s progress throughout the semester[1]. 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 practical examination 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**[1] - 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**[1] - 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[2]. 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.[2]

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.

For more rules, pattern and assessment of semester examination refer[1]

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**Abbreviations**

<table>
<thead>
<tr>
<th>TW: Term Work</th>
<th>TH: Theory</th>
<th>PR: Practical</th>
</tr>
</thead>
<tbody>
<tr>
<td>OR: Oral</td>
<td>TUT: Tutorial</td>
<td>Sem: Semester</td>
</tr>
</tbody>
</table>

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%202019%20Patt_10.012020.pdf

[2] https://swayam.gov.in/about
Semester V
Savitribai Phule Pune University  
Third Year of Artificial Intelligence and Data Science (2019 Course)  
310241: Database Management Systems

<table>
<thead>
<tr>
<th>Teaching Scheme:</th>
<th>Credit: 03</th>
<th>Examination Scheme:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture: 03 Hours/Week</td>
<td></td>
<td>Mid-Sem (TH): 30 Marks</td>
</tr>
<tr>
<td></td>
<td></td>
<td>End-Sem (TH): 70 Marks</td>
</tr>
</tbody>
</table>

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

**Companion Course:** Software Laboratory I (317523)

**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**

<table>
<thead>
<tr>
<th>Unit I</th>
<th>Introduction to Database Management Systems and ER Model</th>
<th>06 Hours</th>
</tr>
</thead>
</table>

*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

<table>
<thead>
<tr>
<th>Unit II</th>
<th>SQL and PL/SQL</th>
<th>07 Hours</th>
</tr>
</thead>
</table>

*Exemplar/Case Studies*  
Implementation of Unit 1 case study using SQL and PL/SQL.

*Mapping of Course Outcomes for Unit II*  
CO1, CO2
<table>
<thead>
<tr>
<th>Unit III</th>
<th>Relational Database Design</th>
<th>06 Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Relational Model:</strong> Basic concepts, Attributes and Domains, CODD's Rules. <strong>Relational Integrity:</strong> Domain, Referential Integrities, Enterprise Constraints. <strong>Database Design:</strong> Features of Good Relational Designs, Normalization, Atomic Domains and First Normal Form, Decomposition using Functional Dependencies, Algorithms for Decomposition, 2NF, 3NF, BCNF.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#Exemplar/Case Studies
Normalize relational database designed in Unit I.

*Mapping of Course Outcomes for Unit III
CO1, CO3

<table>
<thead>
<tr>
<th>Unit IV</th>
<th>Database Transaction Management</th>
<th>07 Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction to Database Transaction, Transaction states, ACID properties, Concept of Schedule, Serial Schedule. <strong>Serializability:</strong> Conflict and View, Cascaded Aborts, Recoverable and Non-recoverable Schedules. <strong>Concurrency Control:</strong> Lock-based, Time-stamp based Deadlock handling. <strong>Recovery methods:</strong> Shadow-Paging and Log-Based Recovery, Checkpoints. <strong>Log-Based Recovery:</strong> Deferred Database Modifications and Immediate Database Modifications.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#Exemplar/Case Studies
Study of Transaction Management in Postgre SQL

*Mapping of Course Outcomes for Unit IV
CO3, CO4

<table>
<thead>
<tr>
<th>Unit V</th>
<th>NoSQL Databases</th>
<th>07 Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction to Distributed Database System, Advantages, Disadvantages, CAP Theorem. <strong>Types of Data:</strong> Structured, Unstructured Data and Semi-Structured Data. <strong>NoSQL Database:</strong> Introduction, Need, Features. <strong>Types of NoSQL Databases:</strong> Key-value store, document store, graph, wide column stores, BASE Properties, Data Consistency model, ACID Vs BASE, Comparative study of RDBMS and NoSQL. <strong>MongoDB</strong> (with syntax and usage): CRUD Operations, Indexing, Aggregation, MapReduce, Replication, Sharding.</td>
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#Exemplar/Case Studies
Use of NoSQL databases for processing unstructured data from social media.

*Mapping of Course Outcomes for Unit V
CO5, CO6

<table>
<thead>
<tr>
<th>Unit VI</th>
<th>Advances in Databases</th>
<th>07 Hours</th>
</tr>
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<tbody>
<tr>
<td><strong>Emerging Databases:</strong> Active and Deductive Databases, Main Memory Databases, Semantic Databases. <strong>Complex Data Types:</strong> Semi-Structured Data, Features of Semi-Structured Data Models. <strong>Nested Data Types:</strong> JSON, XML. <strong>Object Orientation:</strong> Object-Relational Database System, Table Inheritance, Object-Relational Mapping. <strong>Spatial Data:</strong> Geographic Data, Geometric Data.</td>
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</table>

#Exemplar/Case Studies
Applications of advanced databases in real time environment.

*Mapping of Course Outcomes for Unit VI
CO5, CO6
Curriculum for Third Year of Artificial Intelligence and Data Science (2019 Course), Savitribai Phule Pune University

**Learning Resources**

**Text Books:**

**Reference Books:**

**e-Books:**
1. SQL and Relational Theory
   a. (How to Write Accurate SQL code), C.J. Date, O’REILLY Publication

**MOOCs Courses Links:**

@ The CO-PO Mapping Matrix

<table>
<thead>
<tr>
<th>CO/PO</th>
<th>PO1</th>
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Curriculum for Third Year of Artificial Intelligence and Data Science (2019 Course), Savitribai Phule Pune University

Savitribai Phule Pune University
Third Year of Artificial Intelligence and Data Science (2019 Course)
317521: Computer Networks

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<td>End_Semester(TH): 70 Marks</td>
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</table>

Prerequisite Courses, if any:

Companion Course, if any: CN Laboratory(317527)

Course Objectives:
- To understand the Basics concepts of networking standards, protocols and technologies.
- To learn the different signal transmission, multiplexing techniques.
- To learn the role of protocols at various layers in the protocol stacks.
- To learn the different IEEE standards.

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

CO1: Summarize fundamental concepts of Computer Networks, architectures, protocols and technologies

CO2: Analyze the working of physical layer protocols.

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: Summarize concepts of MAC and Ethernet.

Course Contents

Unit I  
Fundamentals of Computer Network  
(06 Hours)


#Exemplar/Case Studies  
Demonstrate the LAN Network

Mapping of Course Outcomes for Unit I

CO1  

Unit II  
Physical Layer  
(7 Hours)

<table>
<thead>
<tr>
<th>#Exemplar/Case Studies</th>
<th>Study of college campus network</th>
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</table>

### Unit III

<table>
<thead>
<tr>
<th>Network Layer</th>
<th>(7 Hours)</th>
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</table>

**Introduction:** Functions of Network layer. **Switching Techniques:** Circuit switching, Message Switching, Packet Switching. **IP Protocol:** Classes of IP (Network addressing), IPv4, IPv6, Network Address Translation, Sub-netting, CIDR. **Network layer Protocols:** ARP, RARP, ICMP, IGMP. **Network Routing and Algorithms:** Static Routing, Dynamic Routing, Distance Vector Routing, Link State Routing, Path Vector. **Routing Protocols:** RIP, OSPF, BGP, MPLS. **Routing in MANET:** AODV, DSR, Mobile IP.

<table>
<thead>
<tr>
<th>#Exemplar/Case Studies</th>
<th>Simulation of Network Layer Protocol</th>
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<table>
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<th>Mapping of Course Outcomes for Unit III</th>
<th>CO2</th>
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### Unit IV

<table>
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<tr>
<th>Transport Layer</th>
<th>(7 Hours)</th>
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</table>

**Process to Process Delivery,** Services, Socket Programming. **Elements of Transport Layer Protocols:** Addressing, Connection establishment, Connection release, Flow control and buffering, Multiplexing, Congestion Control. **Transport Layer Protocols:** TCP and UDP, SCTP, RTP, Congestion control and Quality of Service (QoS), Differentiated services, TCP and UDP for Wireless networks.

<table>
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<tr>
<th>#Exemplar/Case Studies</th>
<th>Simulation of Demonstration of Transport layer protocols.</th>
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<table>
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### Unit V

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<th>Application Layer</th>
<th>(6 Hours)</th>
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**Client Server Paradigm,** Peer to Peer Paradigm, Communication using TCP and UDP services, Domain Name System (DNS), HyperText Transfer Protocol (HTTP), Email: SMTP, MIME, POP3, Webmail, FTP, TELNET, Dynamic Host Control Protocol (DHCP), Simple Network Management Protocol (SNMP).

<table>
<thead>
<tr>
<th>#Exemplar/Case Studies</th>
<th>Study of Application Layer protocols using network protocol analyzer. e.g. Wireshark</th>
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</table>

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<thead>
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<th>CO5</th>
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### Unit VI

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<th>Medium Access Control</th>
<th>(6 Hours)</th>
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</table>

**Channel allocation:** Static and Dynamic, Multiple Access Protocols: Pure and Slotted ALOHA, CSMA, WDMA, IEEE 802.3 Standards and Frame Formats, CSMA/CD, Binary Exponential Back-off algorithm, Fast Ethernet, Gigabit Ethernet, IEEE 802.11a/b/g/n and IEEE 802.15 and IEEE 802.16 Standards, Frame formats, CSMA/CA.

<table>
<thead>
<tr>
<th>#Exemplar/Case Studies</th>
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</table>

<table>
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# Learning Resources

## Text Books:

## Reference Books:

## e-Books:

## MOOC Courses:

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<td>CO/ PO</td>
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http://collegecirculr.unipune.ac.in/sites/documents/Syllabus2022/Forms/AllItems.aspx
### Curriculum for Third Year of Artificial Intelligence and Data Science (2019 Course), Savitribai Phule Pune University

#### 310252: Web Technology

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<td>End-Sem (TH): 70 Marks</td>
</tr>
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</table>

**Prerequisites Courses:**

**Companion Course:** Database Management Systems (310241), Computer Networks (317521)

### Course Objectives:

- To learn the fundamentals of web essentials and markup languages
- To use the Client side technologies in web development
- To use the Server side technologies in web development
- To understand the web services and frameworks

### Course Outcomes:

On completion of the course, learners should be able to

- **CO1:** Implement and analyze behavior of web pages using HTML and CSS
- **CO2:** Apply the Client side technologies for web development
- **CO3:** Analyze the concepts of Servlet and JSP
- **CO4:** Analyze the Web services and frameworks
- **CO5:** Apply the server side technologies for web development
- **CO6:** Create the effective web applications for business functionalities using latest web development platforms

### Course Contents

#### Unit I

**Web Essentials and Mark-up language- HTML**

7 Hours

The Internet, basic internet protocols, the World Wide Web, HTTP Request message, HTTP response message, web clients, web servers. **HTML:** Introduction, history and versions. **HTML elements:** headings, paragraphs, line break, colors and fonts, links, frames, lists, tables, images and forms, Difference between HTML and HTML5. **CSS:** Introduction to Style Sheet, CSS features, CSS core syntax, Style sheets and HTML, Style rule cascading and inheritance, text properties. Bootstrap.

**#Exemplar/Case Studies**

Create a style sheet suitable for blogging application using HTML and using style sheet

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

CO1

#### Unit II

**Client Side Technologies: JavaScript and DOM**

7 Hours

**JavaScript:** Introduction to JavaScript, JavaScript in perspective, basic syntax, variables and data types, statements, operators, literals, functions, objects, arrays, built in objects, JavaScript debuggers. **DOM:** Introduction to Document Object Model, DOM history and levels, intrinsic event handling, modifying element style, the document tree, DOM event handling, jQuery, Overview of Angular JS.

**#Exemplar/Case Studies**

Enhancement in created blogging application using JavaScript (Add Entry feature)

**#Mapping of Course Outcomes for Unit II**

CO2

#### Unit III

**Java Servlets and XML**

7 Hours

http://collegecirculars.unipune.ac.in/sites/documents/Syllabus2022/Forms/AllItems.aspx
**Servlet:** Servlet architecture overview, A “Hello World” servlet, Servlets generating dynamic content, Servlet life cycle, parameter data, sessions, cookies, URL rewriting, other Servlet capabilities, data storage, Servlets concurrency, databases (MySQL) and Java Servlets. **XML:** XML documents and vocabularies, XML declaration, XML Namespaces, DOM based XML processing, transforming XML documents, DTD: Schema, elements, attributes. **AJAX:** Introduction, Working of AJAX.

<table>
<thead>
<tr>
<th>#Exemplar/Case Studies</th>
<th>Develop server-side code for blogging application</th>
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<tbody>
<tr>
<td><strong>Mapping of Course Outcomes for Unit III</strong></td>
<td>CO3</td>
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<tr>
<td><strong>JSP and Web Services</strong></td>
<td>07 Hours</td>
</tr>
</tbody>
</table>

**JSP:** Introduction to Java Server Pages, JSP and Servlets, running JSP applications, Basic JSP, JavaBeans classes and JSP, Support for the Model-View-Controller paradigm, JSP related technologies. **Web Services:** Web Service concepts, Writing a Java Web Service, Writing a Java web service client, Describing Web Services: WSDL, Communicating Object data: SOAP. **Struts:** Overview, architecture, configuration, actions, interceptors, result types, validations, localization, exception handling, annotations.

<table>
<thead>
<tr>
<th>#Exemplar/Case Studies</th>
<th>Transform the blogging application from a loose collection of various resources (servlets, HTML documents, etc.) to an integrated web application that follows the MVC paradigm</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mapping of Course Outcomes for Unit IV</strong></td>
<td>CO3, CO4</td>
</tr>
<tr>
<td><strong>Unit V</strong></td>
<td><strong>Server Side Scripting Languages</strong></td>
</tr>
</tbody>
</table>

**PHP:** Introduction to PHP, uses of PHP, general syntactic characteristics, Primitives, operations and expressions, output, control statements, arrays, functions, pattern matching, form handling, files, cookies, session tracking, using MySQL with PHP, WAP and WML. **Introduction to ASP.NET:** Overview of the .NET Framework, Overview of C#, Introduction to ASP.NET, ASP.NET Controls, Web Services. Overview of Node JS.

<table>
<thead>
<tr>
<th>#Exemplar/Case Studies</th>
<th>Use of PHP in developing blogging application.</th>
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<tbody>
<tr>
<td><strong>Mapping of Course Outcomes for Unit V</strong></td>
<td>CO5, CO6</td>
</tr>
<tr>
<td><strong>Unit VI</strong></td>
<td><strong>Ruby and Rails</strong></td>
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</tbody>
</table>

**Introduction to Ruby:** Origins & uses of Ruby, scalar types and their operations, simple input and output, control statements, fundamentals of arrays, hashes, methods, classes, code blocks and iterators, pattern matching. **Introduction to Rails:** Overview of Rails, Document Requests, Processing Forms, Rails Applications and Databases, Layouts, Rails with Ajax. Introduction to EJB.

<table>
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<tr>
<th>#Exemplar/Case Studies</th>
<th>Study of dynamic web product development using ruby and rails</th>
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<tbody>
<tr>
<td><strong>Mapping of Course Outcomes for Unit VI</strong></td>
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**Learning Resources**


http://collegecirculars.unipune.ac.in/sites/documents/Syllabus2022/Forms/AllItems.aspx
Reference Books:

e-Books:
- https://www.w3.org/html/
- http://w3schools.org/
- http://php.net/
- https://jquery.com/
- http://www.tutorialspoint.com/css/

MOOCs Courses link:
- https://www.digimat.in/nptel/courses/video/106105191/L01.html

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# Curriculum for Third Year of Artificial Intelligence and Data Science (2019 Course)

**Savitribai Phule Pune University**  
**Third Year of Artificial Intelligence and Data Science (2019 Course)**  
**310253: Artificial Intelligence**

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<td>End-Sem (TH): 70 Marks</td>
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**Prerequisites Courses:** Programming and Problem solving (110005), Data Structures and Algorithms (210252)

**Companion Course:** Software Laboratory I (317523)

**Course Objectives:**
- To understand the concept of Artificial Intelligence (AI) in the form of various Intellectual tasks
- To understand Problem Solving using various peculiar search strategies for AI
- To understand multi-agent environment in competitive environment
- To acquaint with the fundamentals of knowledge and reasoning
- To devise plan of action to achieve goals as a critical part of AI
- To develop a mind to solve real world problems unconventionally with optimality

**Course Outcomes:**

**After completion of the course, students should be able to**

- **CO1:** Identify and apply suitable Intelligent agents for various AI applications
- **CO2:** Build smart system using different informed search / uninformed search or heuristic approaches
- **CO3:** Identify knowledge associated and represent it by ontological engineering to plan a strategy to solve given problem
- **CO4:** Apply the suitable algorithms to solve AI problems
- **CO5:** Implement ideas underlying modern logical inference systems
- **CO6:** Represent complex problems with expressive yet carefully constrained language of representation

**Course Contents**

<table>
<thead>
<tr>
<th>Unit I</th>
<th>Introduction</th>
<th>07 Hours</th>
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</table>

**#Exemplar/Case Studies**

Kroger: How This U.S. Retail Giant Is Using AI And Robots To Prepare For The 4th Industrial Revolution

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

CO1, CO4

<table>
<thead>
<tr>
<th>Unit II</th>
<th>Problem-solving</th>
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</table>

**#Exemplar/Case Studies**

4th Industrial Revolution Using AI, Big Data And Robotics

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http://collegecirculars.unipune.ac.in/sites/documents/Syllabus2022/Forms/AllItems.aspx
**Curriculum for Third Year of Artificial Intelligence and Data Science (2019 Course), Savitribai Phule Pune University**

<table>
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<th>Unit III</th>
<th>Adversarial Search and Games</th>
<th>07 Hours</th>
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<tbody>
<tr>
<td></td>
<td>Game Theory, Optimal Decisions in Games, Heuristic Alpha–Beta Tree Search, Monte Carlo Tree Search, Stochastic Games, Partially Observable Games, Limitations of Game Search Algorithms, Constraint Satisfaction Problems (CSP), Constraint Propagation: Inference in CSPs, Backtracking Search for CSPs.</td>
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**#Exemplar/Case Studies**

Machine Learning At Google: The Amazing Use Case Of Becoming A Fully Sustainable Business

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**#Exemplar/Case Studies**

BBC To Launch AI - Enabled Interactive Radio Show For Amazon Echo And Google Home Chat bots

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<td>Inference in First-Order Logic, Propositional vs. First-Order Inference, Unification and First-Order Inference, Forward Chaining, Backward Chaining, Resolution, Knowledge Representation, Ontological Engineering, Categories and Objects, Events, Mental Objects and Modal Logic, Reasoning Systems for Categories, Reasoning with Default Information</td>
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**#Exemplar/Case Studies**

The Amazing Ways How Wikipedia Uses Artificial Intelligence

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**#Exemplar/Case Studies**

The Amazing Ways Samsung Is Using Big Data, Artificial Intelligence And Robots To Drive Performance

<table>
<thead>
<tr>
<th>Unit</th>
<th>Learning Resources</th>
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<tbody>
<tr>
<td></td>
<td><strong>Text Books:</strong></td>
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Reference Books:

e-Books :
- http://aima.cs.berkeley.edu/

MOOCs Courses link:
- https://nptel.ac.in/courses/106/102/106102220/
- https://nptel.ac.in/courses/106/105/106105077/
- https://nptel.ac.in/courses/106/105/106105078/
- https://nptel.ac.in/courses/106/105/106105079/

@ The CO-PO Mapping Matrix

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</table>
**Savitribai Phule Pune University**  
**Third Year of Artificial Intelligence and Data Science (2019 Course)**  
**Elective I**  
**317522(A): Embedded Systems and Security**

<table>
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<th>Teaching Scheme:</th>
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**Prerequisite Courses, if any:** 217529: Internet of Things  
**Companion Course, if any:** Elective I Laboratory (317525)

**Course Objectives:**
- To understand what is an Embedded systems & its development tools  
- To understand ARM 7 architecture and its features  
- To learn the Embedded C programming  
- To study RTOS concepts  
- To learn Embedded Linux and its toolchain  
- To learn Embedded system security threats

**Course Outcomes:**

On completion of the course, learner will be able to—
- CO1: Differentiate between Embedded System & general computing systems  
- CO2: Describe ARM MCU Architecture and its features  
- CO3: Design Embedded firmware using Embedded C  
- CO4: Apply the fundamentals of RTOS to design Embedded Systems  
- CO5: Build the Embedded Linux based Embedded System  
- CO6: Summarize Embedded system security threats and solutions

**Course Contents**

<table>
<thead>
<tr>
<th>Unit I</th>
<th>Introduction to Embedded Systems</th>
<th>(6 Hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fundamental of Embedded system, Embedded systems v/s general purpose systems, classification of Embedded system, Applications, Purpose of an Embedded System, Typical embedded system, Elements of ES, Core of Embedded system, Memory, Sensors and Actuators, Communication Interface, Embedded Firmware, Other components, Characteristics and Quality attributes of Embedded systems, Application and domain specific examples of Embedded systems.</td>
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</table>

**#Exemplar/Case Studies**  
Embedded System for Smart Card reader/Embedded System for Robotic Arm Movement control using web server

**Mapping of Course Outcomes for Unit I**

<table>
<thead>
<tr>
<th>Unit II</th>
<th>ARM Architecture</th>
<th>(8 Hours)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>The ARM Core, The ARM Microcontroller, RISC vs CISC, Advance Features, Architecture versions, ARM cortex, Features of ARM which makes it Special, Operating modes, Register set, Mode switching, Conditional Flags, Interrupt vector table, Features of the LPC 214x Family, Block diagram of LPC 2148 ARM microcontroller, Memory Map, GPIO, Timer, PWM Unit, UART, ARM 9 &amp; Cortex introduction/features.</td>
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</table>

**#Exemplar/Case Studies**  
Study any one ARM 7 based development board. Example: STM Nucleo Board/MCB 2140

**Mapping of Course Outcomes for Unit II**

<table>
<thead>
<tr>
<th>Unit III</th>
<th>Embedded Firmware Design and Development</th>
<th>(8 Hours)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Embedded firmware design approach, Embedded firmware development languages: Assembly and high level languages, conversion steps, advantages and limitations, Programming in Embedded C: C v/s Embedded c, Compiler v/v cross compiler, Library &amp; user defined functions, Pre-processors and Macros, Programming of ARM 7 GPIO pins &amp; peripherals like Timer, PWM, UART using C, Integration of Hardware &amp; firmware, IDE’s for embedded system development, types of file generated on cross compilation, simulators, emulators and debugging.</td>
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</table>
#Exemplar/Case Studies | Study KEIL or any suitable Embedded Development Tools
---|---
**Mapping of Course Outcomes for Unit III** | **CO3**

<table>
<thead>
<tr>
<th>Unit IV</th>
<th>Embedded/Real Time Operating System Concepts</th>
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RTOS, The Real Time Kernel, its basic functions, Hard & soft real time, Tasks, Process & Threads, Multitasking, its types, Task Scheduling, Task Communication, Mailbox, Semaphore, how to Choose RTOS. Introduction to RTOS μCOS-II, its features, source files and system level functions.

#Exemplar/Case Studies | Study the features of μCOS-III
---|---

**Mapping of Course Outcomes for Unit IV** | **CO4**

<table>
<thead>
<tr>
<th>Unit V</th>
<th>Embedded Linux</th>
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</table>

Introduction to embedded Linux, Embedded Linux system architecture, Advantages of Linux, examples of embedded Linux based systems, Embedded hardware for Linux, software components, Linux kernel features, kernel architecture and configuration, root file systems, device tree. Embedded Linux development environment, cross compilation toolchain, boot loaders, tool utilities such as Minicomp, Busybox, Redboot, Libc, Device drivers- concept, architecture, types, sample characteristic of device driver.

#Exemplar/Case Studies | Study the kernel Analysis system
---|---

**Mapping of Course Outcomes for Unit V** | **CO5**

<table>
<thead>
<tr>
<th>Unit VI</th>
<th>Embedded Systems Security</th>
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<td>(6 Hours)</td>
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</table>


#Exemplar/Case Studies | VxWorks Debug Port Vulnerability
---|---

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

Learning Resources

**Text Books:**
1. Introduction to Embedded Systems, Shibu K V, MHE India

**Reference Books:**
5. Parag H Dave, Himanshu H. Dave, Embedded systems Concepts, design and programming, Pearson India
6. Embedded Systems Security, David Kleidermacher, Mike Kleidermacher

**e-Books:**
2. [https://tec.gov.in/pdf/Studypaper/Embedded%20system%20security.pdf](https://tec.gov.in/pdf/Studypaper/Embedded%20system%20security.pdf)

**MOOC Courses:**
1. Embedded System Design With ARM, By Prof. IndranilSengupta, Prof. Kamalika Dutta, IIT Kharagpur

@The CO-PO mapping table
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Savitribai Phule Pune University  
Third Year of Artificial Intelligence and Data Science (2019 Course) 
Elective I  
314445 (C): Design Thinking

<table>
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<tr>
<th>Teaching Scheme:</th>
<th>Credit</th>
<th>Examination Scheme:</th>
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<td>TH: 03 Hours/Week</td>
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<td>Mid_Semester(TH): 30 Marks</td>
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<td>End_Semester(TH): 70 Marks</td>
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</table>

Prerequisite Courses, if any: Programming and Problem Solving, Software Engineering

Companion Course, if any: Elective I Laboratory (317525)

Course Objectives:
- To learn the Design thinking basic concepts.
- To identify the opportunities and challenges for design thinking innovation.
- To describe, define and ideate process of design thinking.
- To summarize the prototyping techniques.
- To enlist the activities carried out in Test and reflect phase of design thinking.
- To Interpret Design Thinking case studies.

Course Outcomes:
On completion of the course, learner will be able to—
- CO1: Identify need and features of design thinking.
- CO2: Identify the opportunities and challenges for design thinking innovation.
- CO3: Learn the process of design thinking using various tools.
- CO4: Summarize and learn the various prototyping techniques.
- CO5: Enlist the activities carried out in Test and reflect phase of design thinking.
- CO6: Interpret the design thinking disruptive innovations through case studies.

Course Contents

<table>
<thead>
<tr>
<th>Unit I</th>
<th>INTRODUCTION TO DESIGN THINKING (06 Hours)</th>
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<tbody>
<tr>
<td></td>
<td><strong>#Exemplar/Case Studies</strong></td>
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<td><strong>Mapping of Course Outcomes for Unit I</strong></td>
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<tr>
<th>Unit II</th>
<th>EXPLORE AND EMPATHIZE (06 Hours)</th>
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<tbody>
<tr>
<td></td>
<td><strong>Explore- STEEP Analysis</strong></td>
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<table>
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<tr>
<th>Unit III</th>
<th>DEFINE AND IDEATE (06 Hours)</th>
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<tbody>
<tr>
<td></td>
<td><strong>Define- Define Point of view</strong></td>
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<td><strong>#Exemplar/Case Studies</strong></td>
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</table>
### CO3: Mapping of Course Outcomes for Unit III

**Unit IV**

**PROTOTYPE** (06 Hours)

**Get Visual, Design Principals, Determine What to Prototype, Storyboard**

- Prototype - How to carry out Prototyping? Frequently used kinds of prototypes, Focused experiments
  - Critical Experience Prototype (CEP) & Critical Function Prototype (CFP), Crazy experiments – Darkhorse Prototype, Combined experiments – Funky prototype
  - Prototyping -Paper Prototyping, Digital Prototyping- Wireframe vs Realistic Prototypes, HTML vs WYSIWYG Editors, Additional Tools for Prototyping, Working with a Developer, Prototype Examples

**#Exemplar/Case Studies**

Understanding Design Thinking & People Centered Design

**Mapping of Course Outcomes for Unit IV**

**CO4**

**Unit V**

**TEST AND REFLECT** (06 Hours)


**#Exemplar/Case Studies**

Study UberEATS

**Mapping of Course Outcomes for Unit V**

**CO5**

**Unit VI**

**DISRUPTIVE INNOVATION** (06 Hours)

Reimagining the Trade Show Experience at IBM, Redesigning the Customer Contact Center at Toyota, Social Networking at MeYou Health, Rethinking Subsidized Meals for the Elderly at The Good Kitchen THE SOCIAL PROBLEM

- Design Thinking in Healthcare with IDEO, Design Thinking Transformed Airbnb, IBM Design Thinking:
  - A Framework To Help Teams Continuously Understand and Deliver, UberEATS.

**#Exemplar/Case Studies**

Design Thinking - Health Care Industry

**Mapping of Course Outcomes for Unit VI**

**CO6**

### Learning Resources

**Text Books:**

2. Mr Lee Chong Hwa (Lead Facilitator), “The Design Thinking: Guidebook”

**Reference Books:**


**e-Books:**

1. Design Thinking - A Primer online course video lectures by IIT Madras (freevideolectures.com)

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http://collegecirculars.unipune.ac.in/sites/documents/Syllabus2022/Forms/AllItems.aspx #26/105
2. NPTEL: Humanities and Social Sciences - NOC: Understanding Design Thinking & People Centered Design
3. NPTEL: Management - NOC: Design Thinking - A Primer
5. UberEATS: [https://medium.com/uber-design/how-we-design-on-the-ubereats-teamff7c41fffbb76](https://medium.com/uber-design/how-we-design-on-the-ubereats-teamff7c41fffbb76)

**MOOC Courses:**

@The CO-PO mapping table

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</table>
Savitribai Phule Pune University
Third Year of Artificial Intelligence and Data Science (2019 Course)
Elective I
317522(B): Pattern Recognition

Teaching Scheme: | Credit | Examination Scheme: |
--- | --- | ---
TH: 03 Hours/Week | 03 | Mid_Semester(TH): 30 Marks

End_Semester(TH): 70 Marks

Prerequisite Courses, if any: --- Basics of Automata Theory

Companion Course, if any: Elective I Laboratory (317525)

Course Objectives:
- To understand fundamentals of pattern recognition.
- To Study syntactic approach in pattern recognition.
- To study statistical approach in pattern recognition.
- To study artificial neural network-based pattern recognition.

Course Outcomes:
On completion of the course, learner will be able to—
- CO1: Distinguish variety of pattern recognition, classification and combination techniques.
- CO2: Apply statistical pattern recognition approaches in variety of problems.
- CO3: Elaborate different approaches of syntactic pattern recognition.
- CO4: Differentiate graphical approach and grammatical inferences in syntactic pattern recognition.
- CO5: Illustrate the artificial neural network-based pattern recognition.
- CO6: Apply unsupervised learning in pattern recognition.

Course Contents

Unit I: Introduction to Pattern Recognition (07 Hours)

Pattern Recognition, Classification and Description. Pattern and Feature Extraction with Examples: Patterns and Features, Pattern Distortions, Examples: Features Extraction Using Generalized Cylinders for 3-D object Description and Classification, Generating RST Invariant Features and Application to 2-D Figure Recognition, The Feature Vector and Feature Space, Classifiers, Decision Regions and Boundaries and Discriminant Functions, Training and Learning in PR Systems: using A Priori knowledge or Experience, Learning Curves, Training Approaches, Pattern Recognition Approaches: Statistical, Syntactic, Neural Pattern Recognition Approach, Examples of Pattern Recognition Approaches.

#Exemplar/Case Studies
Black Box Approaches to Pattern Recognition

Mapping of Course Outcomes for Unit I
CO1

Unit II: Statistical Pattern Recognition (07 Hours)


#Exemplar/Case Studies
statistical pattern recognition in image processing

Mapping of Course Outcomes for Unit II
CO2

Unit III: Syntactic Pattern Recognition (07 Hours)

<table>
<thead>
<tr>
<th>#Exemplar/Case Studies</th>
<th>Block World Description</th>
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<table>
<thead>
<tr>
<th>Mapping of Course Outcomes for Unit III</th>
<th>CO3</th>
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<tr>
<th>Unit IV</th>
<th>Graphical Approaches &amp; Grammatical Inference in Syntactic Pattern Recognition (07 Hours)</th>
</tr>
</thead>
</table>

**Graphical Approaches:** Graph Based Structural Representation, Graph Isomorphism, A Structured Strategy to Compare Attribute Graphs, Other Attributed Graph Distance or Similarity measures. **Learning Via Grammatical Inference:** Learning Grammars, Problem formulation, Grammatical Inference (GI) Approaches, Procedures to Generate Constrained Grammars.

<table>
<thead>
<tr>
<th>#Exemplar/Case Studies</th>
<th>Structural Unification Using Attributed Graphs</th>
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<thead>
<tr>
<th>Mapping of Course Outcomes for Unit IV</th>
<th>CO4</th>
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<tr>
<th>Unit V</th>
<th>Neural Pattern Recognition (07 Hours)</th>
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</table>

**Introduction to Neural Networks:** Neurons and Neural Nets, Neural Network Structures for PR Applications, Physical Neural Networks, The Artificial Neural Network Model. **Introduction to Neural Pattern Associators and Matrix Approaches:** Neural Network Based Pattern Associators, Matrix Approaches (Linear Associative Mappings) and Examples.

<table>
<thead>
<tr>
<th>#Exemplar/Case Studies</th>
<th>Hardware Realizations of Neural Network</th>
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<tr>
<th>Unit VI</th>
<th>Feedforward Networks &amp; Unsupervised Learning in Neural Pattern Recognition (07 Hours)</th>
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<tr>
<th>#Exemplar/Case Studies</th>
<th>Examples of Content Addressable Memory Applications in PR: Character Recognition, Relational Constraint Satisfaction(Coloring)</th>
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<thead>
<tr>
<th>Mapping of Course Outcomes for Unit VI</th>
<th>CO6</th>
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**Learning Resources**

Reference Books:
1. Earl Gose, Richard Johnsonbaugh, Steve Jost, “Pattern Recognition and Image Analysis”

e-Books:

MOOC Courses:
1. https://nptel.ac.in/courses/117105101
2. https://nptel.ac.in/courses/106106046

@The CO-PO mapping table

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Savitribai Phule Pune University
Third Year of Artificial Intelligence and Data Science (2019 Course)
Elective I

310245(B): Human Computer Interface

Teaching Scheme:
Lecture: 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: Elective I Laboratory (317525)

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


#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

Know your user/client: 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. Design Guidelines: Navigating the interface, Organizing the display, Getting user’s attention, Facilitating data entry. Principles: Determine user’s skill level, Identify the tasks, Choose an interaction style, Natural Language, Eight Golden rules of Interface design, Prevent errors, Ensuring
### Unit III: Interaction Styles and HCI in Software Process (7 Hours)

**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.

<table>
<thead>
<tr>
<th>Exemplar/Case Studies</th>
<th>Comparison - GUI and Web design with a real time example.</th>
</tr>
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<tbody>
<tr>
<td>Mapping of Course Outcomes for Unit III</td>
<td>CO1, CO3, CO5</td>
</tr>
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</table>

### Unit IV: Usability Evaluation and Universal Design (7 Hours)

**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.

<table>
<thead>
<tr>
<th>Exemplar/Case Studies</th>
<th>GOMS model - Adding items to a cart of e-shopping website.</th>
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<tbody>
<tr>
<td>Mapping of Course Outcomes for Unit IV</td>
<td>CO1, CO3</td>
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### Unit V: HCI Paradigms (7 Hours)

**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.

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<tr>
<th>Exemplar/Case Studies</th>
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<td>Mapping of Course Outcomes for Unit V</td>
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### Unit VI: HCI for Mobile and Handheld Devices (7 Hours)

**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 systems.
interfaces, Designing for audible interfaces.

**Exemplar/Case Studies**
- GUI in Python
- Enlist and evaluate handled devices

**Mapping of Course Outcomes for Unit VI**
- CO3, CO5, CO6

**Learning Resources**

**Text Books:**

**Reference Books:**

**e-Books:**
- [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)

**MOOCs Courses link**
- [https://www.edx.org/course/human-computer-interaction-i-fundamentals-design-p](https://www.edx.org/course/human-computer-interaction-i-fundamentals-design-p)

**The CO-PO Mapping Matrix**

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**Prerequisite Courses, if any:** Fundamentals of Data Structures (210242), Data Structures and Algorithms (210253)

**Companion Course, if any:** Artificial Intelligence (310253), Database Management Systems (310241)

**Course Objectives:**
- To learn and apply various search strategies for AI
- To formalize and implement constraints in search problems
- To develop basic Database manipulation skills
- To develop skills to handle NoSQL database
- To learn understand to develop application using SQL or NoSQL databases.

**Course Outcomes:**

On completion of the course, learner will be able to—
- **CO1:** Implement SQL queries for given requirements, using different SQL concepts
- **CO2:** Implement NoSQL queries using MongoDB
- **CO3:** Design and develop application using database considering specific requirements
- **CO4:** Design a system using different informed search / uninformed search or heuristic approaches
- **CO5:** Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning.
- **CO6:** Design and develop an interactive AI application

**Guidelines for Instructor's Manual**
The instructor's manual is to be developed as a reference and hands-on resource. It should include prologue (about University/program/institute/department/foreword/preface), curriculum of the course, conduction and Assessment guidelines, topics under consideration, concept, objectives, outcomes, set of typical applications/assignments/guidelines, and references.

**Guidelines for Student's Laboratory Journal**
The laboratory assignments are to be submitted by student in the form of journal. Journal consists of Certificate, table of contents, and handwritten write-up of each assignment (Title, Date of Completion, Objectives, Problem Statement, Software and Hardware requirements, Assessment grade/marks and assessor's sign, Theory Concept in brief, algorithm, flowchart, test cases, Test Data Set (if applicable), mathematical model (if applicable), conclusion/analysis. Program codes with sample output of all performed assignments are to be submitted as softcopy. As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal must be avoided. Use of DVD containing students programs maintained by Laboratory In-charge is highly encouraged. For reference one or two journals may be maintained with program prints in the Laboratory.

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

**Guidelines for Practical Examination**
Problem statements must be decided jointly by the internal examiner and external examiner. During practical assessment, maximum weightage should be given to satisfactory implementation of the problem statement. Relevant questions may be asked at the time of evaluation to test the student’s understanding of the fundamentals, effective and efficient implementation. This will encourage, transparent evaluation and fair approach, and hence will not create any uncertainty or doubt in the minds of the students. So, adhering to these principles will consummate our team efforts to the promising start of student's academics.
Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy need to address the average students and inclusive of an element to attract and promote the intelligent students. Use of open source software is encouraged. Based on the concepts learned. Instructor may also set one assignment or mini-project that is suitable to AI & DS branch beyond the scope of the syllabus.

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

List of Assignments

Group A (DBMS) Perform 6 assignment
(Any 5 Assignments from 1 - 6. Assignment 7 is compulsory)

1. SQL Queries:
   - Design and Develop SQL DDL statements which demonstrate the use of SQL objects such as Table, View, Index, Sequence, Synonym, different constraints etc.
   - 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.

2. SQL Queries – all types of Join, Sub-Query and View:
   - 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

3. MongoDB Queries:
   - Design and Develop MongoDB Queries using CRUD operations. (Use CRUD operations, SAVE method, logical operators etc.).

4. Unnamed PL/SQL code block: Use of Control structure and Exception handling is mandatory.
   - Suggested Problem statement:
     Consider Tables:
     1. Borrower (Roll_no, Name, Date_of_Issue, Name_of_Book, Status)
     2. Fine (Roll_no, Date, Amt)
     - Accept Roll_no and Name_of_Book from user.
     - Check the number of days (from Date_of_Issue).
     - If days are between 15 to 30 then fine amount will be Rs 5 per day.
     - If no. of days>30, per day fine will be Rs 50 per day and for days less than 30, Rs. 5 per day.
     - After submitting the book, status will change from I to R.
     - If condition of fine is true, then details will be stored into fine table.
     - Also handles the exception by named exception handler or user define exception handler.
   - OR
     - MongoDB – Aggregation and Indexing: Design and Develop MongoDB Queries using aggregation and indexing with suitable example using MongoDB.
     - MongoDB – Map-reduce operations: Implement Map-reduce operation with suitable example using MongoDB.

5. Exporting and Importing data
   - Design and develop SQL DML statements to demonstrate exporting tables to external files of different file formats ex. CSV, XLSX, TXT, etc.
   - Design and develop SQL DML statements to demonstrate importing data from external files of different file formats ex. CSV, XLSX, TXT, etc.

6. Cursors: (All types: Implicit, Explicit, Cursor FOR Loop, Parameterized Cursor)
   - Write a PL/SQL block of code using parameterized Cursor that will merge the data available in the newly created table N_Roll_Call with the data available in the table O_Roll_Call. If the data in the first table already exists in the second table then that data should be skipped.
   - Note: Instructor will frame the problem statement for writing PL/SQL block using all types of Cursors in line with above statement.

7. Database Connectivity:
   - Write a program to implement MySQL/Oracle database connectivity with any front end language to implement Database navigation operations (add, delete, edit etc.)
### Group B (Artificial Intelligence) Perform 6 assignment
(Any 5 Assignments from 1 - 6. Assignment 7 is compulsory)

1. Implement depth first search algorithm and Breadth First Search algorithm. Use an undirected graph and develop a recursive algorithm for searching all the vertices of a graph or tree data structure.

2. Implement A star (A*) Algorithm for any game search problem.

3. Implement Alpha-Beta Tree search for any game search problem.

4. Implement a solution for a Constraint Satisfaction Problem using Branch and Bound and Backtracking for n-queens problem or a graph coloring problem.

5. Implement Greedy search algorithm for any of the following application:
   - Selection Sort
   - Minimum Spanning Tree
   - Single-Source Shortest Path Problem
   - Job Scheduling Problem
   - Prim's Minimal Spanning Tree Algorithm
   - Kruskal's Minimal Spanning Tree Algorithm
   - Dijkstra's Minimal Spanning Tree Algorithm

6. Develop an elementary chatbot for any suitable customer interaction application.

7. Mini Project: Implement any one of the following Expert System
   - Information management
   - Hospitals and medical facilities
   - Help desks management
   - Employee performance evaluation
   - Stock market trading
   - Airline scheduling and cargo schedules

### Group C [DBMS] Mini Project

Develop an application with following details:
1. Follow the same problem statement decided in Assignment-1 of Group A.
2. Follow the Software Development Life cycle and other concepts learnt in Software Engineering Course throughout the implementation.
3. Develop application considering:
   - Front End: Python/Java/PHP/Perl/Ruby/.NET/ or any other language
   - Backend: MongoDB/ MySQL/ Oracle / or any standard SQL / NoSQL database
4. Test and validate application using Manual/Automation testing.
5. 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:
   - Title of the Project, Abstract, Introduction
   - Software Requirement Specification (SRS)
   - Conceptual Design using ER features, Relational Model in appropriate Normalize form
   - Graphical User Interface, Source Code
   - Testing document
   - Conclusion.

**Note:** Instructor should maintain progress report of mini project throughout the semester from project group.

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### Learning Resources

http://collegecirculars.unipune.ac.in/sites/documents/Syllabus2022/Forms/AllItems.aspx
Text Books:

Reference Books:

e-Books:
http://vlabs.iitb.ac.in/vlabs-dev/labs/dblab/labs/index.php

MOOC Courses:

@The CO-PO mapping table

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Savitribai Phule Pune University
Third Year of Artificial Intelligence and Data Science (2019 Course)
317524: CN Laboratory

Teaching Scheme:  Credit  Examination Scheme:
PR:  02 Hours/Week  01  Term Work (TW):  25 Marks
Practical(PR):  25 Marks

Prerequisite Courses, if any:

Companion Course, if any: Computer Network(317522)

Course Objectives:
1. To learn computer network hardware and software components
2. To learn computer network topologies and types of network
3. To develop an understanding of various protocols, modern technologies and applications
4. To learn modern tools for network traffic analysis
5. To learn network programming

Course Outcomes:
On completion of the course, learner 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

List of Assignments

Group A (Any four assignment)

1. Demonstrate the different types of topologies and types of transmission media by using a packet tracer tool.

2. 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.

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. Use packet Tracer tool for configuration of 3 router networks using one of the following protocols RIP/OSPF/BGP.

5. Write a program to demonstrate Sub-netting and find subnet masks.

6. Write a program to implement link state /Distance vector routing protocol to find a suitable path for transmission.

Group B (any six)

7. Socket Programming using C/C++/Java.
   a. TCP Client, TCP Server
   b. UDP Client, UDP Server
8. Write a program using TCP socket for wired network for following
   a. Say Hello to Each other
   b. File transfer

9. Write a program using UDP Sockets to enable file transfer (Script, Text, Audio and Video one file each) between two machines.

10. Capture packets using Wireshark and accomplish the following and save the output in file:
    a. Capture all TCP traffic to/from Facebook, during the time when you log in to your Facebook account
    b. Capture all HTTP traffic to/from Facebook (other website), when you log in to your Facebook account
    c. 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.
    d. Count how many TCP packets you received from / sent to Facebook (other website), and how many of each were also HTTP packets.

11. Study and Analyze the performance of HTTP, HTTPS and FTP protocol using Packet tracer tool.

12. To study the SSL protocol by capturing the packets using Wireshark tool while visiting any SSL secured website (banking, e-commerce etc.).

13. Illustrate the steps for implementation of S/MIME email security, POP3 through Microsoft® Office Outlook.

14. To study the IPsec (ESP and AH) protocol by capturing the packets using Wireshark tool.

**Group C (Compulsory)**

15. Installing and configuring DHCP server and assign IP addresses to client machines using DHCP server.

16. Write a program for DNS lookup. Given an IP address input, it should return URL and vice versa.

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Teaching Scheme: 02 Hours/Week  Credit: 01  Examination Scheme:  
PR: 02 Hours/Week  Term Work (TW): 25 Marks  Oral(OR): 25 Marks

Prerequisite Courses: (217531) Internet of Things laboratory

Companion Course: 317522(A) Embedded Systems and Security

Course Objectives: To prepare students for ‘Embedded Software Engineering’ career

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

- CO1: Design Embedded firmware using Embedded C
- CO2: Apply the fundamentals of RTOS to design Embedded Systems
- CO3: Build the Embedded Linux based Embedded System

Instruction:
1. Practical’s can be performed on a suitable ARM based development Board.
2. Perform total 8 experiments; Group A: All; Group B: Any two, Group C: Any two

List of Assignments

Group A
1. To display hexadecimal count with delay on 8 LED’s interfaced to GPIO pins of ARM
2. To interface 16x2 LCD to ARM Microcontroller
3. To Program on chip ADC of ARM & display the values on hyperterminal
4. To generate the waveform using on chip DAC of ARM Microcontroller

Group B (Any Two)
5. To port ucos-II on the ARM controller & implement any task
6. To port Embedded Linux on ARM controller & implement any task
7. To load and remove device driver from Kernel

Group C (Any Two)
8. To Implement multitasking with ucos-II on ARM controller
9. To implement semaphore with ucos –II for resource management and synchronization
10. To implement mailbox for message passing between two tasks
11. To write device driver with Embedded Linux

Learning Resources

Text Books:
1. Introduction to Embedded Systems, Shibu K V, MHE India

Reference Books:

e-Books:
- [https://tec.gov.in/pdf/Studypaper/Embedded%20sys%20security.pdf](https://tec.gov.in/pdf/Studypaper/Embedded%20sys%20security.pdf)

MOOC Courses:
- Embedded System Design With ARM, By Prof. Indranil Sengupta, Prof. Kamalika Dutta, IIT Kharagpur
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Curriculum for Third Year of Artificial Intelligence and Data Science (2019 Course), Savitribai Phule Pune University

Teaching Scheme: Credit Examination Scheme:
PR: 02 Hours/Week 01 Term Work (TW): 25 Marks

Oral(OR): 25 Marks

Prerequisite Courses: Programming and Problem Solving, Software Engineering

Companion Course: 317522(B) Design Thinking

Course Objectives:
- To identify the opportunities and challenges for design thinking innovation and empathize and ideate for it.
- To describe the solution by prototyping the design

Course Outcomes:
On completion of the course, students will be able to—
- CO1: Frame and Design Challenge by performing STEEP Analysis, Conduct Interviews, design and ask 5x Why and 5W+H questions.
- CO2: Demonstrate the activities to empathize with the users by creation of Empathy Map, Persona Development, Customer Journey Map.
- CO3: Define and ideate process of design thinking and perform brainstorming, selection of ideas, create a storyboard and design paper prototyping or digital prototyping for chosen design challenge.

Guidelines for Lab Conduction
1. Students should be asked to form a group of 3 to 4 students and identify design challenge to provide the solution to real life engineering problems within the social, environmental and economic context.
2. All the assignments should be conducted using the templates provided in the reference books.
3. The faculty member should help student to identify Online free or open source tools like diagrams.net, LucidChart, Draw.io, Creatly, Openboard, Microsoft whiteboard etc. which will help students to collaborate and draw diagram.
4. After every assignment, student group should be asked to demonstrate their design and discuss findings.

List of Assignments (All Compulsory)

Group A
1. Inspiration Phase: Perform STEEP analysis by using MAKING SENSE OF STEEP ANALYSIS & STRATEGIC PRIORITIES TEMPLATE and Frame Your Design Challenge. Conduct Interviews, design and ask 5x Why and 5W+H questions
2. Empathize Phase: Observe the user and design Empathy Map, Generate persona/User profile and Customer Journey map

Group B
3. Define and Ideate: Share Stories and learning from research- Cluster Insights into themes, Create Insights statements, create ‘How might we’ questions
4. Prototype Phase: Brainstorm, select your ideas, create a storyboard, determine what to prototype, start prototyping, Design Paper Prototype/digital Prototype, test your prototype and get feedback, Create your Action plan, create pitch, share your solution, perform reflection

Group C
5. Study and present any two case studies of Design thinking from https://www.design-thinking-association.org/explore-design-thinking-topics/external-links/design-thinking-case-study-index or Refer any white Papers available on Internet for case study on design Thinking
Learning Resources

Text Books:
2. Mr Lee Chong Hwa (Lead Facilitator), “The Design Thinking: Guidebook”

Reference Books:

e-Books:

MOOC Courses:
- https://nptel.ac.in/courses/110106124
- https://www.simplilearn.com/learn-design-thinking-basics-free-course-skillup

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# Curriculum for Third Year of Artificial Intelligence and Data Science (2019 Course), Savitribai Phule Pune University

## 317525: Elective I Laboratory Pattern Recognition

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**Prerequisite Course:** Basics of Automata Theory

**Companion Course:** 317522(C): Pattern Recognition

**Course Objectives:**
- To understand fundamentals of pattern recognition.
- To study syntactic approach in pattern recognition.
- To study statistical approaches in pattern recognition.
- To study artificial neural network-based pattern recognition

**Course Outcomes:**
On completion of the course, learner will be able to
- **CO1:** Apply statistical pattern recognition approaches.
- **CO2:** Implement different approaches of syntactic pattern recognition.
- **CO3:** Develop artificial neural network-based pattern recognition system

**List of Assignments (All Compulsory)**

### Group A
- Use Bayesian Decision theory of statistical pattern recognition to classify the object
- Implement Cocke–Younger–Kasami (CYK) Parsing Algorithm using Syntactic Pattern Recognition

### Group B
- Generate a Pattern from String using syntactical Pattern Approach
- Apply suitable pattern recognition technique to perform Character Recognition

### Group C
- Develop a system for Handwritten Digit Recognition using Neural Network

**Text Books:**

**Reference Books:**
1. Earl Gose, Richard Johnsonbaugh, Steve Jost, “Pattern Recognition and Image Analysis”

**e-Books:**
- [https://darmanto.akakom.ac.id/pengenalanpola/Pattern%20Recognition%204th%20%20Ed.%20%2009.pdf](https://darmanto.akakom.ac.id/pengenalanpola/Pattern%20Recognition%204th%20%20Ed.%20%2009.pdf)
- [https://www.inf.ed.ac.uk/teaching/courses/nlu/assets/reading/Gurney_et_al.pdf](https://www.inf.ed.ac.uk/teaching/courses/nlu/assets/reading/Gurney_et_al.pdf)
MOOC Courses:
- [https://nptel.ac.in/courses/117105101](https://nptel.ac.in/courses/117105101)
- [https://nptel.ac.in/courses/106106046](https://nptel.ac.in/courses/106106046)

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http://collegecirculars.unipune.ac.in/sites/documents/Syllabus2022/Forms/AllItems.aspx
Savitribai Phule Pune University
Third Year of Artificial Intelligence and Data Science (2019 Course)

317525: Elective I Laboratory Human Computer Interface

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**Prerequisite Courses, if any:** Computer Graphics, Software Engineering

**Companion Course, if any:** Human Computer Interface (317522(D)):

**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, learner will be able to
- **CO1:** To design effective Human-Computer-Interfaces for all kinds of users
- **CO2:** To apply and analyze the user-interface with respect to golden rules of interface
- **CO3:** To implement the interactive designs for feasible data search and retrieval

**List of Assignments (All Compulsory)**

**Group A**
- List five technologies from the Knowledge Navigator video that were not around in 1987, but are in widespread use today
- Implement GOMS (Goals, Operators, Methods and Selection rules) modelling technique to model user's behavior in given scenario

**Group B**
- Using your observations from your small user study and your knowledge of Web Design guidelines and general UI design principles, Critique two interfaces of any two educational institute and make suggestions for improvement.
- Implement a simple interactive webpage, showing a tabbed UI (which is implemented not through widgets but by interacting with and controlling the Document Object Model with JavaScript and CSS). This page consists of a centered container with 3 tabs each for showing a text, an image and a youtube video. A div containing three Buttons is used as a tab bar and pressing each button displays the corresponding tab. Only one tab should be displayed at a time. The button showing the current tab must remain highlighted from the moment your page is loaded.

**Group C**
- Develop interactive user interfaces using Javascript, CSS and HTML, specifically: a. implementation of form-based data entry, input groups, and button elements using the Bootstrap library. b. use of responsive web design (RWD) principles, c. implementing JavaScript communication between the input forms and a custom visualization component
- Make a Table Lamp in Blender – A 3D modeling software

**Learning Resources**

http://collegecirculars.unipune.ac.in/sites/documents/Syllabus2022/Forms/AllItems.aspx
Text Books:

Reference Books:

e-Books

MOOC Courses:
- https://www.edx.org/course/human-computer-interaction-i-fundamentals-design-p

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Savitribai Phule Pune University
Third Year of Artificial Intelligence and Data Science (2019 Course)

317526: Seminar and Technical Communication

Teaching Scheme
Tutorial: 01 Hour/Week
Credit: 01
Examination Scheme and Marks
Term Work: 25 Marks

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: Analysis specialized topic of interest from core area
CO2: Enhance Technical writing skills
CO3: Targeting specific problem and indentify working solution to resolve it.
CO4: Developing professional communication skill

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.
- All the assignments mentioned below are mandatory
- 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/……Discussion and Conclusions ,Bibliography/References
- Plagiarism Check report
- Report Documentation page

List of Assignments
1. Assignment on selecting technical topic from computer domain; this assignment should include importance of the topic, its impact and future scope.
2. Assignment on analyzing the latest technical topic through literature survey; this assignment may include progress of the topic from last few years like contents from review reports, journals or research papers related to selected topic for seminar work. Students should keep records of all the resources and use citation.

3. Analyze the topic and prepare technical details of the selected topic. This assignment may include contents like architecture details, different modules in detail, algorithms, and hardware details if any.

Reference Books:

@The CO-PO Mapping Matrix

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Prerequisite Courses, if any: Multidisciplinary nature of environmental studies; components of environment – atmosphere, hydrosphere, lithosphere and biosphere.

Companion Course, if any:

Preamble:
An environmental study is a multidisciplinary academic field which systematically studies human interaction with the environment. Environmental studies connect principles from the physical sciences, commerce/economics, the humanities, and social sciences to address complex contemporary environmental issues. Imparting basic knowledge about the environment and its allied problems. Developing an attitude of concern for the environment.

Course Objectives:
- To gain an understanding of the Environment where we live
- Understanding the importance of water
- To educate about Air and Noise pollution
- To explain the concepts of E-waste and Green Computing

Course Outcomes:
On completion of the course, learner will be able to–
- CO1: Aware the importance of environment
- CO2: Understand the water pollution
- CO3: Know the Air and noise pollution
- CO4: Understand the E-waste and green computing

Course Contents

<table>
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<tr>
<th>Unit</th>
<th>Introduction to Environmental Pollution</th>
<th>(03 Hours)</th>
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<tr>
<td>Unit I</td>
<td><strong>Environmental pollution:</strong> Environment and its importance, Definition, Types. Effect of environmental pollution on Plants, Non-living things.</td>
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<th>Unit II</th>
<th>Water Pollution</th>
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<td><strong>Water Pollution:</strong> Definition, Sources of water Pollution, Types of wastewater-Domestic and industrial wastewater</td>
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<th>Unit III</th>
<th>Air Pollution and Noise Pollution</th>
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<td><strong>Air pollution:</strong> Definition, Sources/causes of air pollution. Atmospheric layers, Effects on human. <strong>Noise Pollution:</strong> Definition of Noise Pollution, Types of Noise Pollution</td>
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<th>Unit IV</th>
<th>E-waste Management and Green computing</th>
<th>(03 Hours)</th>
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<tr>
<td><strong>E-waste management:</strong> Definition of E-waste, Sources of E-waste, Types of E-waste <strong>Green computing:</strong> Definition, Objectives of Green Computing, Necessity, Environmental benefits</td>
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Tutorial Conduction and Term work Guidelines (Set of Suggested Activities)

The students are expected to submit
1) Report/Presentation on the effect of Environmental Pollution on any world famous Structure/monument.
2) Report/Presentation on importance of different sources of water available nearby them.
3) Report/Presentation based on the data collected from the local authorities on air pollution and noise pollution.
4) Report/Presentation on the E-Waste generated in the campus.

Learning Resources
Text Books:
5. “Environmental Pollution, monitoring and control”, S. M. Khopkar, New Age Publication.

Reference Books:

Web Links:
1. Prof. Mukesh Sharma, IIT Kanpur https://archive.nptel.ac.in/courses/105/102/105102089


MOOC Courses: https://onlinecourses.swayam2.ac.in/cec21_ge21/preview

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Savitribai Phule Pune University

Third Year of Artificial Intelligence and Data Science (2019 Course)

317528(A): Audit Course 5
AC5-A: Emotional Intelligence

Course Objectives:
- To develop an awareness of Emotional Intelligence models
- To recognize the benefits of Emotional Intelligence
- To understand how to use emotion to facilitate thought and behavior
- To know and utilize the difference between reaction and considered response

Course Outcomes:
On completion of the course, learner will be able to—
- CO1: Expand their knowledge of emotional patterns in themselves and others
- CO2: Discover how to manage their emotions, and positively influence themselves and others
- CO3: Build more effective relationships with people at work and home
- CO4: Positively influence and motivate colleagues, team members and managers
- CO5: Increase their leadership effectiveness by creating an atmosphere that engages others

Course Contents
1. Introduction to Emotional Intelligence (EI) : Emotional Intelligence and various EI models, The EQ competencies of self-awareness, self-regulation, motivation, empathy, and interpersonal skills, Understand EQ and its importance in life and the workplace
2. Know and manage your emotions: Emotions, Different levels of emotional awareness, Increase emotional knowledge of yourself, Recognize ‘negative’ and ‘positive’ emotions, The relationship between emotions, thought and behavior, Discover the importance of values, The impact of not managing and processing ‘negative’ emotions, Techniques to manage your emotions in challenging situations
3. Recognize emotions in others : The universality of emotional expression, Learn tools to enhance your ability to recognize and appropriately respond to others’ emotions, Perceiving emotions accurately in others to build empathy
4. Relate to others: Applying EI in the workplace, the role of empathy and trust in relationships, Increase your ability to create effective working relationships with others (peers, subordinates, managers, clients, Find out how to deal with conflict, Tools to lead, motivate others and create a high performing team.

Learning Resources

Books:

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Savitribai Phule Pune University
Third Year of Artificial Intelligence and Data Science (2019 Course)
317528(B): Audit Course 5
AC5-B: Industrial Safety and Consciousness

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

Course Outcomes:
On completion of the course, learner will be able to—
- CO1: Formulate the plan for safety performance
- CO2: Formulate the action plan for accidents and hazards
- CO3: Follow the safety and security norms in the industry
- CO4: Consider critically the environmental issues of industrialization

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

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

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

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

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

6. Industrial Security (Industry wise)

Learning Resources
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Savitribai Phule Pune University
Third Year of Artificial Intelligence and Data Science (2019 Course)
317528(C): Audit Course
AC5-C: 3D Printing

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

Course Outcomes:
On completion of the course, learner will be able to–
- CO1: Apply models for 3D printing
- CO2: Plan the resources for 3D printing
- CO3: Apply principles in 3D printing in real world

Course Contents
1. **Getting started with 3D Printing:** How 3D Printers fit into Modern Manufacturing, Exploring the Types of 3D Printing, Exploring Applications of 3D Printing.
2. **Outlining 3D Printing Resources:** Identifying Available Materials for 3D Printing, Identifying Available Sources for 3D printable Objects.
3. **Exploring the Business Side of 3D Printing:** Commoditizing 3D Printing, Understanding 3D Printing’s Effect on Traditional lines of Business, Reviewing 3D Printing Research.
4. **Employing Personal 3D printing Devices:** Exploring 3D printed Artwork, Considering Consumer level 3D Printers, Deciding on RepRap of Your Own

Learning Resources

Books:

@The CO-PO mapping table

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</table>
Prerequisite Courses, if any: We recommend that candidates should have previously completed AC3-V(217527-V) and AC4-V (217535-V)

Companion Course, if any:

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

Course Outcomes:
On completion of the course, learner will be able to–
- CO1: Have ability of basic communication.
- CO2: Have the knowledge of Japanese script.
- CO3: Get introduced to reading, writing and listening skills for Japanese language.
- CO4: Develop interest to pursue professional Japanese language course.

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

Learning Resources

@The CO-PO mapping table

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</table>
Course Objectives:
- To promote interactive user forums to support community interactions among students, professors, and experts
- To promote students to learn additional skills anytime and anywhere
- To enhance teaching and learning on campus and online
- To motivate students for self-learning useful for advancing their career

Course Outcomes:
CO1: On completion of the course, learner will acquire additional knowledge and skill.

Course Contents
MOOCs (Massive Open Online Courses) provide affordable and flexible way to learn new skills, pursue lifelong interests and deliver quality educational experiences at scale. It helps you to learn for yourself, to advance your career or leverage online courses to educate your workforce. Platforms such as SWAYAM, NPTEL, edx or similar ones can help for self-learning.

World’s largest SWAYAM MOOCs is a new paradigm of education for anyone, anywhere, anytime, as per your convenience. It aims to provide digital education free of cost and facilitate hosting of all the interactive courses prepared by more than 1000 specially chosen the best faculty and teachers in the country. SWAYAM MOOCs enhance active learning for improving lifelong learning skills by providing easy access to global resources.

SWAYAM is a programme initiated by Government of India and designed to achieve the three cardinal principles of Education Policy viz., access, equity and quality. The objective of this effort is to take the best teaching learning resources to all, including the most disadvantaged. SWAYAM seeks to bridge the digital divide for students who have remained untouched so far by the digital revolution and have not been able to join the mainstream of the knowledge economy.

This is done through an indigenous developed IT platform that facilitates hosting of all the courses, taught in classrooms from 9th class till post-graduation to be accessed by anyone, anywhere, at any time. All the courses are interactive, prepared by the best teachers in the country and are available, free of cost to the residents in India. More than 1,000 specially chosen faculty and teachers from across the Country have participated in preparing these courses.

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

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

Learning Resources

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

@The CO-PO mapping table
*Mapping will vary according to the course selected.

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</table>
Semester VI
Curriculum for Third Year of Artificial Intelligence and Data Science (2019 Course), Savitribai Phule Pune University

### Teaching Scheme: | Examination Scheme:
---|---
TH: 04 Hours/Week | Credit: 03 | Mid_Semester(TH): 30 Marks | End_Semester(TH): 70 Marks

**Prerequisite Courses, if any:** Discrete Mathematics, Database Management Systems

**Companion Course, if any:** Data Science

**Course Objectives:**
- To understand the need of Data Science
- To understand computational statistics in Data Science
- To study and understand the different technologies used for Data processing
- To understand and apply data modeling strategies
- To learn Data Analytics using Python programming
- To be conversant with advances in analytics

**Course Outcomes:**
On completion of the course, learner will be able to—
- CO1: Analyze needs and challenges for Data Science
- CO2: Apply statistics for Data Analytics
- CO3: Apply the lifecycle of Data analytics to real world problems
- CO4: Implement Data Analytics using Python programming
- CO5: Implement data visualization using visualization tools in Python programming
- CO6: Design and implement Big Databases using the Hadoop ecosystem

### Course Contents

#### Unit I
**Introduction to Data Science** (07 Hours)
Basics and need of Data Science, Applications of Data Science, Relationship between Data Science and Information Science, Business intelligence versus Data Science, Data: Data Types, Data Collection. Need of Data wrangling, Methods: Data Cleaning, Data Integration, Data Reduction, Data Transformation, and Data Discretization.

**#Exemplar/Case Studies**
Create academic performance dataset of students and perform data preprocessing using techniques of data cleaning and data transformation.

**Mapping of Course Outcomes for Unit I**
- CO1

#### Unit II
**Statistical Inference** (7 Hours)
Need of statistics in Data Science, Measures of Central Tendency: Mean, Median, Mode, Mid-range. Measures of Dispersion: Range, Variance, Mean Deviation, Standard Deviation. Bayes theorem, Basics and need of hypothesis and hypothesis testing, Pearson Correlation, Sample Hypothesis testing, Chi-Square Tests, t-test.

**#Exemplar/Case Studies**
For an employee dataset, create a measure of central tendency and its measure of dispersion for statistical analysis of given data.

**Mapping of Course Outcomes for Unit II**
- CO2

#### Unit III
**Data Analytics Life Cycle** (7 Hours)

**#Exemplar/Case Studies**
Case study: Global Innovation Social Network and Analysis (GINA).
Curriculum for Third Year of Artificial Intelligence and Data Science (2019 Course), Savitribai Phule Pune University

<table>
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<th>Mapping of Course Outcomes for Unit III</th>
<th>CO3</th>
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</table>

**Unit IV**  
**Predictive Data Analytics with Python**  
(7 Hours)


**#Exemplar/Case Studies**  
Use IRIS dataset from Scikit and apply data preprocessing methods

**Mapping of Course Outcomes for Unit IV**  
CO4, CO2

<table>
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<th>Mapping of Course Outcomes for Unit IV</th>
<th>CO4, CO2</th>
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**Unit V**  
**Data Analytics and Model Evaluation**  
(7 Hours)


**#Exemplar/Case Studies**  
Use IRIS dataset from Scikit and apply K-means clustering methods

**Mapping of Course Outcomes for Unit V**  
CO4, CO2

<table>
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<th>Mapping of Course Outcomes for Unit V</th>
<th>CO4, CO2</th>
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**Unit VI**  
**Data Visualization and Hadoop**  
(7 Hours)

Introduction to Data Visualization, Types of data visualization, Data Visualization Techniques, Tools used in Data Visualization, Challenges to Big data visualization, Visualizing Big Data, Analytical techniques used in Big data visualization, Hadoop ecosystem, Map Reduce, Pig, Hive,. Data Visualization using Python: Line plot, Scatter plot, Histogram, Density plot, Box-plot.

**#Exemplar/Case Studies**  
Use IRIS dataset from Scikit and plot 2D views of the dataset

**Mapping of Course Outcomes for Unit VI**  
CO5, CO6

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

**Text Books:**

**Reference Books:**
1. EMC Education Services, “Data Science and Big Data Analytics- Discovering, analyzing Visualizing and Presenting Data” 1st Edition.

**e-Books:**
1. An Introduction to Statistical Learning by Gareth James
2. Python Data Science Handbook by Jake VanderPlas
3. Hadoop Tutorial:
4. Learning with Python: How to think like a computer scientist:
   [http://openbookproject.net/thinkcs/python/english3e/](http://openbookproject.net/thinkcs/python/english3e/)
5. Scikit Learn Tutorial
   [https://scikit-learn.org/stable/](https://scikit-learn.org/stable/)
7. An introduction to data Science :
   [https://docs.google.com/file/d/0B6iefdnF22XQeVZDSkxjZ0Z5VUE/edit?pli=1](https://docs.google.com/file/d/0B6iefdnF22XQeVZDSkxjZ0Z5VUE/edit?pli=1)

**MOOC Courses:**

**MOOCs Courses links:**
1. Computer Science and Engineering - NOC: Data Science for Engineers
2. Computer Science and Engineering - NOC: Python for Data Science
3. Computer Science and Engineering - NOC: Data Mining
5. Big Data Computing - Course

@The CO-PO mapping table

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</table>
Savitribai Phule Pune University
Third Year of Artificial Intelligence and Data Science (2019 Course)
317530: Cyber Security

Teaching Scheme: Credit Examination Scheme:
TH: 04 Hours/Week## 03 Mid_Semester(TH): 30 Marks
End_Semester(TH): 70 Marks

Prerequisite Courses, if any: Computer Networks (317521)
Companion Course, if any: Mini Project (317536)

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

Course Outcomes:
On completion of the course, learner will be able to—
- CO1: Gauge the security protections and limitations provided by today's technology.
- CO2: Identify cyber security threats.
- CO3: Analyze threats in order to protect or defend it in cyberspace from cyber-attacks.
- CO4: Build appropriate security solutions against cyber-attacks

Course Contents

<table>
<thead>
<tr>
<th>Unit I</th>
<th>Introduction</th>
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#Exemplar/Case Studies
Case study on cyber attacks

Mapping of Course Outcomes for Unit I
C01, C02

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<th>Unit II</th>
<th>Data Encryption Techniques And Standards</th>
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#Exemplar/Case Studies
Symmetric encryption algorithm case study

Mapping of Course Outcomes for Unit II
C03, C04

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<th>Unit III</th>
<th>Public Key And Management</th>
<th>(08 Hours)</th>
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</table>

#Exemplar/Case Study
Public encryption algorithm case study

http://collegecirculars.unipune.ac.in/sites/documents/Syllabus2022/Forms/AllItems.aspx
### Curriculum for Third Year of Artificial Intelligence and Data Science (2019 Course), Savitribai Phule Pune University

<table>
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<th>Studies</th>
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<td><strong>Security Requirements</strong></td>
<td>(08 Hours)</td>
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<td>Cisco Security case study</td>
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<td>Mapping of Course Outcomes for Unit IV</td>
<td>C03, C04</td>
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<td><strong>Unit V</strong></td>
<td><strong>Firewall And Intrusion</strong></td>
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<td>Mapping of Course Outcomes for Unit V</td>
<td>C03, C04</td>
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<tr>
<td><strong>Unit VI</strong></td>
<td><strong>Cyber Forensic, Hacking &amp; its countermeasures</strong></td>
<td>(08 Hours)</td>
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<tr>
<td>Personally Identifiable Information (PII), Cyber Stalking, Cybercrime, PII Confidentiality Safeguards, Information Protection Law: Indian Perspective. Hacking: Remote connectivity and VoIP hacking, Wireless Hacking, Mobile Hacking, countermeasures</td>
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<tr>
<td>#Exemplar/Case Studies</td>
<td>Cyber Forensics, ethical hacking case study</td>
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<tr>
<td>Mapping of Course Outcomes for Unit VI</td>
<td>C03, C04</td>
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### Learning Resources

#### Text Books:


#### Reference Books:

MOOC Courses: [https://onlinecourses.swayam2.ac.in/cec20_cs15/preview](https://onlinecourses.swayam2.ac.in/cec20_cs15/preview)

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Curriculum for Third Year of Artificial Intelligence and Data Science (2019 Course), Savitribai Phule Pune University

Savitribai Phule Pune University
Third Year of Artificial Intelligence and Data Science (2019 Course)
317531: Artificial Neural Network

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<td>TH: 04 Hours/Week</td>
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<td>Mid_Semester(TH): 30 Marks</td>
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<td>End_Semester(TH): 70 Marks</td>
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Prerequisite Courses, if any: Basic knowledge of computer architecture, Artificial Intelligence and Statistics
Companion Course, if any: NIL

Course Objectives:
1. To provide students with a basic understanding of the fundamentals and applications of artificial neural networks
2. To identify the learning algorithms and to know the issues of various feed forward and feedback neural networks.
3. To understand the basic concepts of associative learning and pattern classification.
4. To solve real-world problems using the concept of Artificial Neural Networks.

Course Outcomes:
On completion of the course, learner will be able to—
CO1: Understand the basic features of neural systems and be able to build the neural model.
CO2: Perform the training of neural networks using various learning rules.
CO3: Grasping the use of associative learning Neural Network
CO4: Describe the concept of competitive Neural Networks
CO5: Implement the concept of Convolutional Neural Networks and its models
CO6: Use a new tool/tools to solve a wide variety of real-world problems

Course Contents

<table>
<thead>
<tr>
<th>Unit I</th>
<th>Introduction to ANN</th>
<th>07 Hours</th>
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<tbody>
<tr>
<td></td>
<td>Introduction to ANN, History of Neural Network, Structure and working of Biological Neural Network, Neural net architecture, Topology of neural network architecture, Features, Characteristics, Types, Activation functions, Models of neuron - McCulloch &amp; Pitts model, Perceptron, Adaline model, Basic learning laws, Applications of neural networks, Comparison of BNN and ANN.</td>
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#Exemplar/Case Studies
Controlling Water Reservoirs, Rule Extractions

Mapping of Course Outcomes for Unit I
CO1

<table>
<thead>
<tr>
<th>Unit II</th>
<th>Learning Algorithms</th>
<th>07 Hours</th>
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</thead>
<tbody>
<tr>
<td>Learning and Memory, Learning Algorithms, Numbers of hidden nodes, Error Correction and Gradient Decent Rules, Perceptron Learning Algorithms, Supervised Learning Backpropagation, Multilayered Network Architectures, Back propagation Learning Algorithm, Feed forward and feedback neural networks, example and applications.</td>
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#Exemplar/Case Studies
Medical diagnosis, Automated trading systems

Mapping of Course Outcomes for Unit II
CO2

<table>
<thead>
<tr>
<th>Unit III</th>
<th>Associative Learning</th>
<th>07 Hours</th>
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</table>

#Exemplar/Case Studies
Understanding catastrophic, Interference in neural nets
## Curriculum for Third Year of Artificial Intelligence and Data Science (2019 Course), Savitribai Phule Pune University

### Unit IV: Competitive learning Neural Network (07 Hours)
Components of CL network, Pattern clustering and feature mapping network, ART networks, Features of ART models, character recognition using ART network.
Self-Organization Maps (SOM): Two Basic Feature Mapping Models, Self-Organization Map, SOM Algorithm, Properties of Feature Map, Computer Simulations, Learning Vector Quantization, Adaptive Pattern Classification

<table>
<thead>
<tr>
<th>#Exemplar/Case Studies</th>
<th>A Translation System for Face-to-Face Dialog and Intelligent Help Systems</th>
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<tbody>
<tr>
<td>Mapping of Course Outcomes for Unit IV</td>
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### Unit V: Convolution Neural Network (07 Hours)
Building blocks of CNNs, Architectures, convolution / pooling layers, Padding, Strided convolutions, Convolutions over volumes, SoftMax regression, Deep Learning frameworks, Training and testing on different distributions, Bias and Variance with mismatched data distributions, Transfer learning, multi-task learning, end-to-end deep learning, Introduction to CNN models: LeNet – 5, AlexNet, VGG – 16, Residual Networks

<table>
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<tr>
<th>#Exemplar/Case Studies</th>
<th>Large scale handwritten digit recognition problem</th>
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<tbody>
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<td>Mapping of Course Outcomes for Unit V</td>
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### Unit VI: Applications of ANN (06 Hours)

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<tbody>
<tr>
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</table>

## Learning Resources

### Text Books:

### Reference Books:
1. Artificial Neural Networks - B. Vegnanarayana Prentice Hall of India P Ltd., 2005
2. Neural Networks in Computer Inteligance- Li Min Fu, MC GRAWHILL EDUCATION, 2003

### e-Books:

### MOOC Courses:
1. https://nptel.ac.in/courses/117105084

[http://collegecirculars.unipune.ac.in/sites/documents/Syllabus2022/Forms/AllItems.aspx](http://collegecirculars.unipune.ac.in/sites/documents/Syllabus2022/Forms/AllItems.aspx)
The CO-PO mapping table

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Savitribai Phule Pune University
Third Year of Artificial Intelligence and Data Science (2019 Course)
Elective II
317532(A): Robotics and Automation

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Prerequisite Courses, if any: Internet of Things (217529), Artificial Intelligence (310253)
Companion Course, if any: Mini Project (317536)

Course Objectives:
- To impart knowledge about basic mathematics related to industrial robots
- To Design and control application in robotics & automation Industries

Course Outcomes:
Course Outcomes –
On completion of this course, the learner will be able to -
CO1 – Demonstrate the Sensors, actuators, End effectors,
CO2 – Analyze Robot Kinematics and Dynamics with simulation
CO3 – Summarize control laws for simple robot
CO4 – Develop robot program for robot application

Course Contents

Unit I | Introduction to Automation and Robotics | (06 Hours)
--- | --- | ---
Introduction to Robotics – Laws of Robotics, Robot Anatomy, Classification of Robots, Robots Links and Joints, Degrees of Freedom, Robot Configurations, Work Envelope

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

Unit II | Robot Sensors and Vision | (Hours)
--- | --- | ---
Sensors – Contact and Proximity, Position, Force, velocity, Touch, Range, Tactile, Acoustic, Light Curtain, Sensor Selection
Robot Vision – Components of vision system, image acquisition, Cameras, Image Storage and Image Processing, feature Extraction, Object recognition

#Exemplar/Case Studies
Mapping of Course Outcomes for Unit II
CO1

Unit III | Robot Kinematics and Dynamics | (Hours)
--- | --- | ---
3 Robot Kinematics – Translation and Rotation representation, Coordinate Transformation, Denavit Hartenberg parameters, Forward and Inverse Kinematics, Jacobian, Singularity and Statics
Robot Dynamics – Forward and Inverse Dynamics, Equation of Motion using Euler – Lagrange Formulation and Newton – Euler Formulation

#Exemplar/Case Studies
Case study on kinematic and dynamics of Industrial robot
### Mapping of Course Outcomes for Unit III

<table>
<thead>
<tr>
<th>Unit IV</th>
<th>Robot End Effectors and actuation systems (Hours)</th>
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**Unit IV** | **Robot End Effectors and actuation systems** | **(Hours)** |
---|---|---|
Robot End Effectors – Grippers - Mechanical, Pneumatic, Hydraulic, Magnetic, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers
Actuators - Pneumatic Drives, Hydraulic Drives, Mechanical Drives, Electrical Drives - Servo Motors, Stepper Motors, BLDC motor, Micro actuators, selection of actuators, Power transmission systems for robot, Motion conversion.

#Exemplar/Case Studies
Casestudy on Gripper design

### Mapping of Course Outcomes for Unit IV

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### Unit V | Robot Control System (Hours) |
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**Unit V** | **Robot Control System** | **(Hours)** |
---|---|---|
Embedded Systems – microcontroller architecture, Integration of Sensors and Actuators
Basics of Control – Open and Closed Loop, Transfer Functions, Control Law Partitioning, PID Control, Linear and Nonlinear control, Force / Position Control, Adaptive control
Introduction to Trajectory Planning, Artificial Intelligence in Robotics, Robotic Simulation

#Exemplar/Case Studies
Casestudy on Robot controller

### Mapping of Course Outcomes for Unit V

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### Unit VI | Robot Performance, Applications and programming (Hours) |
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**Unit VI** | **Robot Performance, Applications and programming** | **(Hours)** |
---|---|---|
Robot Performance – Resolution, repeatability, accuracy, dexterity, Compliance, RCC
Applications of Robots – in Unmanned systems, Defense, medical, Industries

#Exemplar/Case Studies
Robot program on palletizing and Depalletizing

### Mapping of Course Outcomes for Unit VI

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### Learning Resources

**Text Books:**
- Groover M.P.- Automation, production systems and computer integrated manufacturing’ - Prentice Hall of India
- Ganesh Hegde, Industrial Robotics, Laxmi publication
- S. K. Saha, Introduction to Robotics, TMH International
- Groover, Industrial Robotics, Tata McGraw-Hill Education

**Reference Books:**
- Mark W Spong, M. Vidyasagar, Robot Dynamics And Control, John Wiley & Sons
- Richard D. Klafter, Robotics Engineering: An Integrated Approach, Pearson

**e-Books:**

**MOOC Courses:**
## The CO-PO mapping table

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### Curriculum for Third Year of Artificial Intelligence and Data Science (2019 Course) Savitribai Phule Pune University

#### 317532(B): Natural Language Processing

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<td>End_Semester(TH): 70 Marks</td>
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#### Prerequisite Courses, if any: Discrete Mathematics (210241), Data Structures and Algorithms (210253), Artificial Intelligence (310254)

#### Companion Course, if any: Artificial Neural Network (317531), Mini Project (317536)

#### Course Objectives:
- To understand the basic concepts of Natural Language Processing (NLP)
- To understand use of morphological aspect in NLP
- To learn and implement syntax parsing techniques
- To learn and implement semantics parsing techniques
- To learn and implement Machine Translation techniques
- To design and develop different application using NLP

#### Course Outcomes:
On completion of the course, learner will be able to—

- **CO1:** Understand the fundamental concepts in field of NLP
- **CO2:** Understand morphological aspect and processing in NLP
- **CO3:** Distinguish among various techniques of syntax parsing
- **CO4:** Understand use of various parsing techniques to parse sentence and extract meaning from its structure.
- **CO5:** Apply different Machine translation techniques for translating a source to target language(s)
- **CO6:** Design and implement different application using NLP

#### Course Contents

**Unit I**

**Fundamentals of Natural Language Processing**

(06 Hours)

- History of NLP, Generic NLP system, levels of NLP, Knowledge in language processing, Ambiguity in Natural language, stages in NLP, challenges of NLP, Applications of NLP, Approaches of NLP: Rule based, Data Based, Knowledge Based approaches

*#Exemplar/Case Studies*

Comparative study of available libraries for Natural Language processing with respect to functionalities provided, platform dependence, supported NLP approaches, supported NLP tasks, advantages and disadvantages etc.

**Mapping of Course Outcomes for Unit I**

CO1

**Unit II**

**Word level processing**

(8 Hours)

- Types of Morphology: English and Indian Languages, Finite-State Morphological Parsing, building a Finite-State Lexicon, Finite-State Transducers, FSTs for Morphological Parsing, Transducers and Orthographic rules, The Porter Stemmer, Word and Sentence Tokenization, Detecting and Correcting Spelling Errors, Minimum Edit Distance, Human Morphological Processing
- N–Grams: Building N-gram for spelling corrections, N-gram for language model.

*#Exemplar/Case Studies*

Morphological Analyzer for Affix Stacking Languages: A Case Study of Marathi

**Mapping of Course Outcomes for Unit II**

CO2

**Unit III**

**Syntax Parsing**

(8 Hours)
**Constituency Grammars:** Context free grammar, grammar rules for English, treebanks, grammar equivalence and normal forms, lexicalized grammar. **Constituency Parsing:** Ambiguity, CKY parsing, span based neural constituency parsing, evaluation parsers, partial parsing, CCG parsing, **Dependency parsing:** dependency relations, dependency formalism, dependency treebank, transition and graph based dependency parsing, evaluations.

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<tr>
<th>#Exemplar/Case Studies</th>
<th>Semantic Parsing</th>
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<td>Dialogue systems and summarization</td>
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| **Word Senses and WordNet:** Word senses, relation between senses, WordNet, wordsense disambiguation, WSD algorithm and task, **Word sense inductions** Semantic role labelling: semantic roles, diathesis alteration, problems with thematic roles, proposition bank, framenet, semantic role labelling, selection restrictions, decomposition of predicates, **Lexicon for sentiment, affect and connotation:** emotions, sentiment and affect lexicons, Creating Affect Lexicons by Human Labeling, Semi-supervised Induction of Affect Lexicons, Supervised Learning of Word Sentiment, Using Lexicons for Sentiment Recognition, Other tasks: Personality, Affect Recognition, Lexicon-based methods for Entity-Centric Affect, Connotation Frames. |

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<tr>
<th><strong>Unit V</strong></th>
<th><strong>Machine Translation (MT)</strong></th>
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<tr>
<td>Need of MT, Problems of Machine Translation, MT Approaches, Direct Machine Translations, Rule-Based Machine Translation, Knowledge Based MT System, Statistical Machine Translation (SMT), Parameter learning in SMT (IBM models) using EM, Encoder-decoder architecture, Neural Machine Translation</td>
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<th><strong>Applications of NLP</strong></th>
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<td>Information retrieval-Vector Space Model, Information Extraction using sequence labelling, Question answers system, categorization, summarization, sentiment analysis, Named Entity Recognition. Analyzing text with NLTK, Chatbot using Dialogflow</td>
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<tr>
<td>1. Steven Bird, Ewan Klein and Edword Loper,” NLP with Python:Analyzing text with the</td>
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Natural Language Toolkit”, O’Reilly Media,Inc

e-Books:
   URL http://u.cs.biu.ac.il/~yogo/nlp.pdf

MOOC Courses:
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Savitribai Phule Pune University

Third Year of Artificial Intelligence and Data Science (2019 Course)

Elective II

310254(C): Cloud Computing

Teaching Scheme:
Lecture: 04 Hours/Week
Credit: 03

Examination Scheme:
Mid-Semester (TH) : 30 Marks
End-Sem (TH): 70 Marks

Prerequisites Courses: Computer Networks (317521)
Companion Course: Mini Project (317536)

Course Objectives:
- To study fundamental concepts of cloud computing
- To learn various data storage methods on cloud
- To understand the implementation of Virtualization in Cloud Computing
- To learn the application and security on cloud computing
- To study risk management in cloud computing
- To understand the advanced technologies in cloud computing

Course Outcomes:
On completion of the course, learners should be able to
- CO1: Understand the different Cloud Computing environment
- CO2: Use appropriate data storage technique on Cloud, based on Cloud application
- CO3: Analyze virtualization technology and install virtualization software
- CO4: Develop and deploy applications on Cloud
- CO5: Apply security in cloud applications
- CO6: Use advance techniques in Cloud Computing

Course Contents

Unit I
Introduction to Cloud Computing
07 Hours

#Exemplar/Case Studies
Cloud Computing Model of IBM

*Mapping of Course Outcomes for Unit I
CO1

Data Storage and Cloud Computing
07 Hours

#Exemplar/Case Studies
Online Book Marketing Service, Online Photo Editing Service

*Mapping of Course Outcomes for Unit II
CO2
<table>
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<tr>
<td>#Exemplar/Case Studies</td>
<td>Cloud Security Tool: Acunetix.</td>
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<thead>
<tr>
<th>Unit VI</th>
<th>Advanced Techniques in Cloud Computing</th>
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<td>Case studies on Dev Ops: DocuSign, Forter, Gengo.</td>
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<td>*Mapping of Course Outcomes for Unit VI</td>
<td>CO6</td>
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| Learning Resources |         |         |
Text Books :

Reference Books :

e-Books :

MOOCs Courses link:
- Cloud Computing https://onlinecourses.nptel.ac.in/noc21_cs14/preview?
- Cloud Computing and Distributed System: https://onlinecourses.nptel.ac.in/noc21_cs15/preview?
- https://www.digimat.in/nptel/courses/video/106105167/L01.html
- https://www.digimat.in/nptel/courses/video/106105167/L03.html
- https://www.digimat.in/nptel/courses/video/106105167/L20.html

@ The CO-PO Mapping Matrix

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Elective II

310254(D): Software Modeling and Architecture

Teaching Scheme:
Lecture: 04 Hours/Week##
Credit: 03

Examination Scheme:
Mid-Semester (TH) : 30 Marks
End-Sem (TH): 70 Marks

Prerequisites Courses: Object Oriented Programming (210243), Software Engineering (210253)
Companion Course: Mini Project (317536)

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

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

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

Course Contents

<table>
<thead>
<tr>
<th>Unit I</th>
<th>Concepts of Software Modeling</th>
<th>07 Hours</th>
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#Exemplar/Case Studies
Requirement modeling and use case modeling for Real life applications (e.g., Online shopping system)

*Mapping of Course Outcomes for Unit I
CO1, CO2

<table>
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<tr>
<th>Unit II</th>
<th>Static Modeling</th>
<th>07 Hours</th>
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Study of classes (analysis level and design level classes). Methods for identification of classes: RUP (Rational Unified Process), CRC (Class, Responsibilities and Collaboration), Use of Noun Verb analysis (for identifying entity classes, controller classes and boundary classes). Class Diagram: Relationship between classes, Generalization/Specialization Hierarchy, Composition and Aggregation Hierarchies, Associations Classes, Constraints. Object diagram, Package diagram, Component diagram, Composite Structure diagram, Deployment Diagram.

http://collegecirculars.unipune.ac.in/sites/documents/Syllabus2022/Forms/AllItems.aspx
<table>
<thead>
<tr>
<th>#Exemplar/Case Studies</th>
<th>UML Static Diagrams for Real life applications (e.g., Online shopping system).</th>
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<tr>
<td>*Mapping of Course Outcomes for Unit II</td>
<td>CO1 ,CO2</td>
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**Unit III**

**Dynamic Modeling**

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**Activity diagram:** Different Types of nodes, Control flow, Activity Partition, Exception handler, Interruptible activity region, Input and output parameters, Pins.

**Interaction diagram:** Sequence diagram, Interaction Overview diagram, State machine diagram, Advanced State Machine diagram, Communication diagram, Timing diagram.

<table>
<thead>
<tr>
<th>#Exemplar/Case Studies</th>
<th>UML dynamic Diagrams of for Real life applications.</th>
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<tr>
<td>*Mapping of Course Outcomes for Unit III</td>
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**Unit IV**

**Software Architecture and Quality Attributes**

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

<table>
<thead>
<tr>
<th>#Exemplar/Case Studies</th>
<th>Case study of any real-life application</th>
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<tr>
<td>*Mapping of Course Outcomes for Unit IV</td>
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**Unit V**

**Architectural Design and Documentation**

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**Unit VI**

**Design Patterns**

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

<table>
<thead>
<tr>
<th>#Exemplar/Case Studies</th>
<th>Flight Simulation</th>
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<tr>
<td>*Mapping of Course Outcomes for Unit VI</td>
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**Learning Resources**


Reference Books:

e-Books:
- https://ebookpdf.com/roger-s-pressman-software-engineering
- https://dhomaseghanshyam.files.wordpress.com/2016/02/gomaa-softwaremodellinganddesign.pdf

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

@ The CO-PO Mapping Matrix

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**Prerequisite Courses, if any:** Software Laboratory I (317526), Elective I Laboratory (317525)

**Companion Course, if any:** Artificial Neural Network (317534)

**Course Objectives:**
- To understand basic techniques and strategies of learning algorithms
- To understand various artificial neural network models
- To make use of tools to solve the practical problems in real field using Pattern Recognition, Classification and Optimization

**Course Outcomes:**
On completion of the course, learner will be able to–
- CO1: Model artificial Neural Network, and to analyze ANN learning, and its applications
- CO2: Perform Pattern Recognition, Linear classification.
- CO3: Develop different single layer/multiple layer Perception learning algorithms

**Guidelines for Instructor's Manual**
The instructor's manual is to be developed as a hands-on resource and reference. The instructor's manual need to include prologue (about University/program/institute/department/foreword/preface), curriculum of 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 prologue, Certificate, table of contents, and hand written write-up of each assignment (Title, Objectives, Problem Statement, Outcomes, software and Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory-Concept in brief, algorithm, flowchart, test cases, Test Data Set(if applicable), mathematical model (if applicable), conclusion/analysis. Program codes with sample output of all performed assignments are to be submitted as softcopy.

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

**Guidelines for Laboratory / Term Work Assessment**
Continuous assessment of laboratory work should be done based on overall performance and Laboratory assignments performance of student. Each Laboratory assignment assessment should be assigned grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each Laboratory assignment assessment include- timely completion, performance, innovation, efficient codes, punctuality and neatness.

**Guidelines for Laboratory Conduction**
The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy need to address the average students and inclusive of an element to attract and promote the intelligent students. The instructor may set multiple sets of assignments and distribute among batches of students. It is appreciated if the assignments are based on real world problems/applications. Encourage students for appropriate use of Hungarian notation, proper indentation and comments. Use of open source software is to be encouraged. In addition to these, instructor may assign one real life application in the form of a mini-project based on the concepts learned. Instructor may also set one assignment or mini-project that is suitable to respective branch beyond the scope of syllabus.

Set of suggested assignment list is provided in groups- A, B, and C. Each student must perform at least
10 assignments and one mini project ( at least 6 from group A, 2 from group B and 2 from group C )  

**Group A and B assignments should be implemented in Python without using built-in methods for major functionality of assignment. Operating System recommended:- 64-bit Open source Linux or its derivative Programming tools recommended: - Open Source Python, Programming tool like Jupyter Notebook, Pycharm, Spyder, Tensorflow.**

### Guidelines for Practical Examination

Both internal and external examiners should jointly set problem statements. During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement. The supplementary and relevant questions may be asked at the time of evaluation to test the student’s for advanced learning, understanding of the fundamentals, effective and efficient implementation. So encouraging efforts, transparent evaluation and fair approach of the evaluator will not create any uncertainty or doubt in the minds of the students. So adhering to these principles will consummate our team efforts to the promising start of the student's academics.

### Virtual Laboratory:

https://cse22-iiith.vlabs.ac.in/

http://vlabs.iitb.ac.in/vlabs-dev/labs/machine_learning/labs/index.php

### Suggested List of Laboratory Experiments/Assignments

#### Group A (Any 6)

1. Write a Python program to plot a few activation functions that are being used in neural networks.
2. Generate ANDNOT function using McCulloch-Pitts neural net by a python program.
3. Write a Python Program using Perceptron Neural Network to recognise even and odd numbers. Given numbers are in ASCII form 0 to 9
4. With a suitable example demonstrate the perceptron learning law with its decision regions using python. Give the output in graphical form.
5. Write a python Program for Bidirectional Associative Memory with two pairs of vectors.
6. Write a python program to recognize the number 0, 1, 2, 39. A 5 * 3 matrix forms the numbers. For any valid point it is taken as 1 and invalid point it is taken as 0. The net has to be trained to recognize all the numbers and when the test data is given, the network has to recognize the particular numbers
8. Create a Neural network architecture from scratch in Python and use it to do multi-class classification on any data. Parameters to be considered while creating the neural network from scratch are specified as:
   (1) No of hidden layers : 1 or more
   (2) No. of neurons in hidden layer: 100
   (3) Non-linearity in the layer : Relu
   (4) Use more than 1 neuron in the output layer. Use a suitable threshold value
   Use appropriate Optimisation algorithm

#### Group B (Any 4)

1. Write a python program to show Back Propagation Network for XOR function with Binary Input and Output
2. Write a python program to illustrate ART neural network.
3. Write a python program in python program for creating a Back Propagation Feed-forward neural network
4. Write a python program to design a Hopfield Network which stores 4 vectors
5. Write Python program to implement CNN object detection. Discuss numerous performance evaluation metrics for evaluating the object detecting algorithms' performance.

#### Group C (Any 3)

1. How to Train a Neural Network with TensorFlow/Pytorch and evaluation of logistic regression using tensorflow
2. TensorFlow/Pytorch implementation of CNN

3. For an image classification challenge, create and train a ConvNet in Python using TensorFlow. Also try to improve the performance of the model by applying various hyper parameter tuning to reduce the overfitting or under fitting problem that might occur. Maintain graphs of comparisons.

4. MNIST Handwritten Character Detection using PyTorch, Keras and Tensorflow

**Mini Project**

Car Object Detection using (ConvNet/CNN) Neural Network

Car Object Data: Data Source – https://www.kaggle.com/datasets/sshikamaru/car-object-detection

The dataset contains images of cars in all views.

Training Images – Set of 1000 files

Use Tensorflow, Keras & Residual Network resNet50

Constructs comparative outputs for various Optimisation algorithms and finds out good accuracy.

OR

Mini Project to implement CNN object detection on any data. Discuss numerous performance evaluation metrics for evaluating the object detecting algorithms’ performance, Take outputs as a comparative results of algorithms.

**Learning Resources**

**Text Books:**


**Reference Books:**

1. Getting Started with TensorFlow, by Giancarlo Zaccone
2. AI and Machine learning for coders by Laurence Moroney, O'Reilly Media, Inc.

**e-Books:**


**MOOC Courses:**

3. https://nptel.ac.in/courses/106106213

@The CO-PO mapping table

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Savitribai Phule Pune University
Third Year of Artificial Intelligence and Data Science (2019 Course)
317534: Software Laboratory III

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<td>Practical (PR): 25 Marks</td>
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Prerequisite Courses, if any: Data Base Management System (310241)

Companion Course, if any: Data Science (317529)

Course Objectives:
- To understand principles of Data Science for the analysis of real time problems
- To develop in depth understanding and implementation of the key technologies in Data Science and Data Analytics
- To analyze and demonstrate knowledge of statistical data analysis techniques for decision-making
- To gain practical, hands-on experience with statistics programming languages and Data tools

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

CO1: Apply principles of Data Science for the analysis of real time problems
CO2: Implement data representation using statistical methods
CO3: Implement and evaluate data analytics algorithms
CO4: Perform text preprocessing
CO5: Implement data visualization techniques
CO6: Use cutting edge tools and technologies to analyze Data

Guidelines for Instructor’s Manual
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Set of suggested assignment list is provided in groups- A and B. Each student must perform 13 assignments (10 from group A, 3 from group B), 2 mini project from Group C  

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

**Programming tools recommended:** - JAVA/Python/R/Scala

**Virtual Laboratory:**
- "Welcome to Virtual Labs - A MHRD Govt of india Initiative"

<table>
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<th>List of Assignments</th>
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<tr>
<td><strong>Group A : Data Science</strong></td>
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1) **Data Wrangling, I**  
Perform the following operations using Python on any open source dataset (e.g., data.csv)

1. Import all the required Python Libraries.  
2. Locate open source data from the web (e.g., https://www.kaggle.com). Provide a clear description of the data and its source (i.e., URL of the web site).  
3. Load the Dataset into pandas dataframe.  
4. Data Preprocessing: check for missing values in the data using pandas isnull(), describe() function to get some initial statistics. Provide variable descriptions. Types of variables etc. Check the dimensions of the data frame.  
5. Data Formatting and Data Normalization: Summarize the types of variables by checking the data types (i.e., character, numeric, integer, factor, and logical) of the variables in the data set. If variables are not in the correct data type, apply proper type conversions.  
6. Turn categorical variables into quantitative variables in Python.  

In addition to the codes and outputs, explain every operation that you do in the above steps and explain everything that you do to import/read/scrape the data set.

2) **Data Wrangling II**  
Create an “Academic performance” dataset of students and perform the following operations using Python.

1. Scan all variables for missing values and inconsistencies. If there are missing values and/or inconsistencies, use any of the suitable techniques to deal with them.  
2. Scan all numeric variables for outliers. If there are outliers, use any of the suitable techniques to deal with them.  
3. Apply data transformations on at least one of the variables. The purpose of this transformation should be one of the following reasons: to change the scale for better understanding of the variable, to convert a non-linear relation into a linear one, or to decrease the skewness and convert the distribution into a normal distribution.  

Reason and document your approach properly.

3) **Descriptive Statistics - Measures of Central Tendency and variability**  
Perform the following operations on any open source dataset (e.g., data.csv)

1. Provide summary statistics (mean, median, minimum, maximum, standard deviation) for a
dataset (age, income etc.) with numeric variables grouped by one of the qualitative (categorical) variable. For example, if your categorical variable is age groups and quantitative variable is income, then provide summary statistics of income grouped by the age groups. Create a list that contains a numeric value for each response to the categorical variable.

2. Write a Python program to display some basic statistical details like percentile, mean, standard deviation etc. of the species of 'Iris-setosa', 'Iris-versicolor' and 'Iris-versicolor' of iris.csv dataset.

Provide the codes with outputs and explain everything that you do in this step.

4) Data Analytics I

Create a Linear Regression Model using Python/R to predict home prices using Boston Housing Dataset (https://www.kaggle.com/c/boston-housing). The Boston Housing dataset contains information about various houses in Boston through different parameters. There are 506 samples and 14 feature variables in this dataset.

The objective is to predict the value of prices of the house using the given features.

5) Data Analytics II

1. Implement logistic regression using Python/R to perform classification on Social_Network_Ads.csv dataset.
2. Compute Confusion matrix to find TP, FP, TN, FN, Accuracy, Error rate, Precision, Recall on the given dataset.

6) Data Analytics III

1. Implement Simple Naïve Bayes classification algorithm using Python/R on iris.csv dataset.
2. Compute Confusion matrix to find TP, FP, TN, FN, Accuracy, Error rate, Precision, Recall on the given dataset.

7) Text Analytics

1. Extract Sample document and apply following document preprocessing methods: Tokenization, POS Tagging, stop words removal, Stemming and Lemmatization.
2. Create representation of documents by calculating Term Frequency and Inverse Document Frequency.

8) Data Visualization I

1. Use the inbuilt dataset 'titanic'. The dataset contains 891 rows and contains information about the passengers who boarded the unfortunate Titanic ship. Use the Seaborn library to see if we can find any patterns in the data.
2. Write a code to check how the price of the ticket (column name: 'fare') for each passenger is distributed by plotting a histogram.

9) Data Visualization II

1. Use the inbuilt dataset 'titanic' as used in the above problem. Plot a box plot for distribution of age with respect to each gender along with the information about whether they survived or not. (Column names : 'sex' and 'age')
2. Write observations on the inference from the above statistics.

10) Data Visualization III

Download the Iris flower dataset or any other dataset into a DataFrame. (e.g., https://archive.ics.uci.edu/ml/datasets/Iris ). Scan the dataset and give the inference as:

1. List down the features and their types (e.g., numeric, nominal) available in the dataset.
2. Create a histogram for each feature in the dataset to illustrate the feature distributions.
3. Create a boxplot for each feature in the dataset.
4. Compare distributions and identify outliers.
1. Create databases and tables, insert small amounts of data, and run simple queries using Impala.

2. Design a distributed application using MapReduce which processes a log file of a system.

3. Write a simple program in SCALA using Apache Spark framework.

**Group C Group C- Mini Projects/ Case Study – PYTHON/R (Any ONE Mini Project)**

1. Write a case study on Global Innovation Network and Analysis (GINA). Components of analytic plan are
   - Discovery business problem framed,
   - Data,
   - Model planning analytic technique and
   - Results and Key findings.

2. Use the following dataset and classify tweets into positive and negative tweets. [https://www.kaggle.com/ruchi798/data-science-tweets](https://www.kaggle.com/ruchi798/data-science-tweets)


4. Use the following covid_vaccine_statewise.csv dataset and perform following analytics on the given dataset [https://www.kaggle.com/sudalairajkumar/covid19-in-india?select=covid_vaccine_statewise.csv](https://www.kaggle.com/sudalairajkumar/covid19-in-india?select=covid_vaccine_statewise.csv)
   a. Describe the dataset
   b. Number of persons state wise vaccinated for first dose in India
   c. Number of persons state wise vaccinated for second dose in India
   d. Number of Males vaccinated
   e. Number of females vaccinated

5. Write a case study to process data driven for Digital Marketing OR Health care systems with Hadoop Ecosystem components as shown. (Mandatory)
   - HDFS: Hadoop Distributed File System
   - YARN: Yet Another Resource Negotiator
   - MapReduce: Programming based Data Processing
   - Spark: In-Memory data processing
   - PIG, HIVE: Query based processing of data services
   - HBase: NoSQL Database (Provides real-time reads and writes)
   - Mahout, Spark MLLib: (Provides analytical tools) Machine Learning algorithm libraries
   - Solar, Lucene: Searching and Indexing

**Learning Resources**

**Reference Books:**

5. Data Analytics with Hadoop, Jenny Kim, Benjamin Bengfort, OReilly Media, Inc.

**References :**

- [https://www.edureka.co/blog/hadoop-ecosystem](https://www.edureka.co/blog/hadoop-ecosystem)
- [https://www.edureka.co/blog/mapreduce-tutorial/#mapreduce_word_count_example](https://www.edureka.co/blog/mapreduce-tutorial/#mapreduce_word_count_example)
Curriculum for Third Year of Artificial Intelligence and Data Science (2019 Course), Savitribai Phule Pune University

- https://spark.apache.org/docs/latest/quick-start.html#more-on-dataset-operations
- https://www.scala-lang.org/

**MOOC Courses:**
- https://onlinecourses.nptel.ac.in/noc21_cs33/preview
- https://nptel.ac.in/courses/106/104/106104189/
- https://onlinecourses.nptel.ac.in/noc20_cs92/preview
- https://nptel.ac.in/courses/106/106/106106212/

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Savitribai Phule Pune University  
Third Year of Artificial Intelligence and Data Science (2019 Course)  
317535: Internship

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Course Objectives:
- To provide the work experience that can help students to put their education into practice.
- To encourage and provide opportunities for students to get professional experience through internships.
- To learn and apply knowledge gained through academics to real life/industrial situations.
- To get familiar with various technologies and tools used in industries for development of their applications.
- To inculcate professional and societal ethics.
- To create awareness of social, economic and administrative considerations in the working environment of industry organizations.

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

CO1: To demonstrate professional competence through industry internship.

CO2: To apply knowledge gained through academics to a professional environment during internship.

CO3: To select appropriate technology and tools to solve a given real time problem.

CO4: To demonstrate abilities of a responsible professional and use ethical practices in day today life.

CO5: To create professional and social network and develop relationships with industry people and get exposure to future employers.

CO6: To explore various career opportunities in different domains and decide career goals.

Guidelines:
Internships are skill development, making students aware about the industrial environment, professional ethics, and career development opportunities. Students with well-identified internship goals make better utilization of practical experience in a field/broad area chosen.

The well-skilled and properly groomed interns are always in demand for industries/organizations. Industrial internships are like learning in the supervised mode and shaping one's career with pre identified goals. It's an important aspect as employers are looking for employees who are skilled and aware of the industry environment, practices, procedures, and culture. The intern will focus on a particular task or part of the project concisely as it is structured, short-term, and supervised.

The engineering undergraduate can be exposed to the procedures and practices followed in the industry through the traditional teaching-learning process but it is always restricted by the simulation horizons so it is being placed on the actual background to gear up the skills. An opportunity, of engineering internships, will help interns to gear up and affirm conceptual learning in academics.

Duration
Internship is to be completed after semester 5 and before commencement of semester 6 of at least 4 to 6 weeks; and it is to be assessed and evaluated in semester 6.

Internship Work Identification
The student may choose to undergo an Internship in Industry/Government
Organizations/NGO/MSME/Rural Internship/ Innovation/IPR/Entrepreneurship. The student may choose either to work on innovation or entrepreneurial activities resulting in start-up or undergo internships with industry/NGO’s/Government organizations/Micro/Small/ Medium enterprises to make themselves ready for the industry[1].

Students must register at Internshala[2]. Students must get Internship proposals sanctioned by the college authorities well in advance. The internship work identification process should be initiated in the semester-5 in coordination with the training and placement cell/ industry-institute cell/ internship cell. This will help students to start their internship work on time. Internship is to be completed after semester-5 and before commencement of semester-6 of at least 4 to 6 weeks and it is to be assessed and evaluated in semester-6.

Students can take internship work in the form of the following but not limited to:

- Working for a consultancy/ research project
- Contribution in Incubation/ Innovation/ Entrepreneurship Cell/ Institutional Innovation
- Council/ startups cells of institute
- Learning at the Departmental Lab/Tinkering Lab/ Institutional workshop,
- Development of new product/ Business Plan/ registration of start-up
- Industry / Government Organization Internship
- Internship through Internshala
- In-house product development, intercollegiate, inter-department research internship under research lab/group, micro/small/medium enterprise/online internship
- Research internship under professors, IISC, IIT’s, Research organizations
- NGOs or Social Internships, rural internships
- Participate in open source development.

**Internship Diary/Internship Workbook**

Students must maintain an Internship Diary/ Internship Workbook. The main purpose of maintaining a diary/workbook is to cultivate the habit of documenting. The students should record in the daily training diary the day-to-day account of the observations, impressions, information gathered, and suggestions given if any. The training diary/workbook should be signed every day by the supervisor.

Internship Diary/workbook and Internship Report should be submitted by the students along with attendance record and an evaluation sheet duly signed and stamped by the industry supervisor to the Institute immediately after the completion of the training.

**Internship Work Evaluation**

Every student needs to prepare and maintain the documents with valid evidence of the activities done by him/her in the form of an internship diary or an internship workbook. The evaluation of these activities will be carried out by the Programme Head/Internship In-charge/Project Head/ Faculty mentor or Industry supervisor based on a satisfactory compilation of internship activities /sub-activities, effective practical work, domain knowledge, well understanding of concepts, the level of achievement expected, the evidence needed to assign the points and the duration for certain activities. Assessment and evaluation are to be done in consultation with the internship supervisor (Internal and External supervisors from the place of internship)

Recommended evaluation parameters:
- Post Internship, Internal Evaluation Term work (Internship Diary/Workbook and Internship Report) - 50 Marks and Oral/Seminar Presentation – 50 Marks
- Evaluation through seminar presentation at the Institute

The student will give a seminar based on his internship report/workbook before the panel of experts.
constituted by the concerned department as per the norms of the institute.

The evaluation will be based on the following criteria:

- Domain knowledge and skill
- Presentation/communication skill
- Teamwork
- Innovation/Creativity
- Planning & Organizational skills
- Adaptability
- Analytical Skills
- Attitude & Behavior at work
- Societal Understanding
- Ethics
- Regularity and punctuality
- Attendance record
- Diary/Workbook
- Student’s Feedback from External Internship Supervisor

After completion of the Internship, the student should prepare a comprehensive report that includes what he/she has observed, monitored and learnt during the training period.

**The internship Diary/workbook may be evaluated on the basis of following parameters:**

- Proper and timely documented entries
- Time to time maintaining the internship diary
- Adequacy & quality of information recorded
- Relevant information gathered and analyzed
- Thought process and recording tools and techniques used
- Structuring the information

**Internship Report**

The report shall be prepared and presented covering the following recommended fields but limited to,

- Title/Cover Page
- Internship completion certificate
- Internship Place Details - Company background-organization and activities/Scope and object of the study / Supervisor details
- Index/Table of Contents
- Introduction
- Title/Problem statement/objectives
- Motivation/Scope and rationale of the study
- Methodological details (tools and techniques used)
- Results / Analysis /Inferences
- Conclusion and future scope
- Suggestions / Recommendations for improvement to industry (if any)
- Attendance Record
- Acknowledgement
- List of references (Library books, magazines, web references and other sources)

**Feedback from internship supervisor(External and Internal)**

After completion of internship, the faculty coordinator should collect feedback about the student with the following recommended parameters:

Technical knowledge gained through internship, Discipline, Sincerity and Punctuality, Commitment, Willingness to do the work, Individual work, Team work, Leadership, Verbal and written communication skills.
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### Curriculum for Third Year of Artificial Intelligence and Data Science (2019 Course)

#### 317536: Mini Project

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**Prerequisite Courses, if any:** Computer Networks (317521)

**Companion Course, if any:** Cyber Security (317530), Elective II**

## Part A Cyber Security

### Course Objectives:
- To understand threats/vulnerabilities to networks and countermeasures.
- To provide understanding of cryptography and its applications.
- To explain various approaches to Encryption techniques.
- To understand working of firewall and IDs.

### Course Outcomes:

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

- **CO1**: Identify basic security attacks and services
- **CO2**: Analyze the vulnerabilities and design a security solution.
- **CO3**: Implement symmetric and asymmetric key algorithms
- **CO4**: Demonstrate network security applications, Firewall, IDs.

### List of Assignments (any five assignments)

1. Implementation of S-DES
2. Implementation of S-AES
3. Implementation of Diffie-Hellman key exchange
4. Implementation of RSA.
5. Implementation of ECC algorithm.
6. Enable/Configure (windows/ubuntu) firewall. Create rules to filter network traffic and to block unauthorized network traffic.
7. Configure and demonstrate an Intrusion Detection System (IDS) to detect suspicious activities and generate alerts when detected.

### Mini Project (any one)

8. Mini Project 1: Implement Cross Site Scripting using stored attack. A stored cross-site scripting vulnerability in the comment functionality. [Note: To implement this assignment, submit a comment that calls the alert function when the blog post is viewed.]
9. Mini Project 2: Implement SQL injection vulnerability attack that causes the application to display details of all the products available on website.
10. Mini Project 3: Design the Access control vulnerability. [Note: This assignment has an unprotected admin panel. It is located at an unpredictable location, but the location is disclosed somewhere in the application. Use https://portswigger.net]
11. Mini Project 4: This task is to demonstrate insecure and secured website. Develop a web site and demonstrate how the contents of the site can be changed by the attackers if it is http based and not secured. You can also add payment gateway and demonstrate how money transactions can be hacked by the hackers. Then support your website having https with SSL and demonstrate how secured website is.

### Learning Resources

**Text Books:**

http://collegecirculars.unipune.ac.in/sites/documents/Syllabus2022/Forms/AllItems.aspx

Reference Books:

e-Books: [https://heimdalsecurity.com/pdf/cyber_security_for_beginners_ebook.pdf](https://heimdalsecurity.com/pdf/cyber_security_for_beginners_ebook.pdf)

MOOC Courses:

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Part B : Elective II : Robotics and Automation

Prerequisite Courses, if any:

Companion Course, if any:

Course Objectives:
- To study and survey recent trends in NLP
- To learn and implement different pre-processing techniques
- To design and develop different applications using NLP

Course Outcomes:
On completion of the course, learner will be able to--
CO1: Understand recent trends in NLP
CO2: Implement different pre-processing techniques
CO3: Design and develop various application using NLP

List of Assignments
1. Study Components of Industrial Robot (PUMA, KUKA, FANUC, Motomanetc) and its DH parameters.
2. Design and selection of Gripper / End effector
3. Two Programming exercise on lead through programming for Industrial Application
4. Program for Forward and Inverse kinematics of simple robot configuration (Robo Analyzer/ MATLAB or Open Source)
5. Control experiment using available Hardware or Software (Open Source or MATLAB)
6. Study of robotic system design.
7. Study of sensor integration.
8. Use of open source computer vision programming tool / Matlab, Open CV
9. Report on industrial application of robot /Industrial visit

Note: Choose any 4 assignments from Assignment 1 to Assignment 5 and any 1 assignment
Curriculum for Third Year of Artificial Intelligence and Data Science (2019 Course), Savitribai Phule Pune University

Learning Resources

Text Books:
1. Groover M.P.- Automation, production systems and computer integrated manufacturing’ - Prentice Hall of India
4. Ganesh Hegde, Industrial Robotics, Laxmi publication
5. S. K. Saha, Introduction to Robotics, TMH International

Reference Books:
1. Mark W Spong, M. Vidyasagar, Robot Dynamics And Control, John Wiley & Sons

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Part B: Elective II: Natural Language Processing

Prerequisite Courses, if any: Discrete Mathematics, Data Structure, Artificial Intelligence

Companion Course, if any: Artificial Neural Network

Course Objectives:
- To study and survey recent trends in NLP
- To learn and implement different pre-processing techniques
- To design and develop different applications using NLP

Course Outcomes:
On completion of the course, learner will be able to—
- CO1: Understand recent trends in NLP
- CO2: Implement different pre-processing techniques
- CO3: Design and develop various application using NLP

List of Assignments
1] Survey of Recent Advances in NLP:
   Detailed survey of recent efforts being taken in the field of NLP with respect to approaches, applications, problems etc.

2] To perform various preprocessing tasks in NLP:
   Perform various basic pre-processing tasks like tokenization, stemming, lemmatization, stop word removal etc. using inbuilt functions and using regular expressions.

3] Perform Spelling Correction:
   Apply minimum edit distance between two strings for spelling correction.

4] Implement a system to detect different types of toxicity like threats, obscenity, insults, and identity-based hate from comments. (Dataset: Wikipedia comments which have been labeled by
human raters for toxic behavior. You can download dataset from
https://www.kaggle.com/competitions/jigsaw-toxic-comment-classification-challenge/data

5] Recommendation system using Voice Chatbot. (Use of Google speech engine)

6] Examiner less oral examination system (Speech to text and answer matching)

Note: Assignments 1-4 are mandatory. Perform any 1 from 5, 6.

Learning Resources

Text Books:

Reference Books:

e-Books:

MOOC Courses:

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Part B : Elective II : Cloud Computing

Prerequisite Courses, if any: Database Management System (310241)

Companion Course, if any:

Course Objectives:
- To learn AWS environment.
- To learn Amazon RDS.
- To design and develop different applications using Amazon Services.

Course Outcomes:
On completion of the course, learner will be able to:
- CO1: Understanding of AWS environment.
- CO2: Understand Amazon RDS
- CO3: Understand and use of AWS Lightsail

List of Assignments
1. Setting up AWS Environment: Create a new AWS account, secure the root user, create an IAM user to use in the account. Set up the AWS CLI, set up a Cloud9 environment.

2. Setup, create and visualize data in an Amazon Relational Database (Amazon RDS) MS SQL Express server using Amazon Quick Sight.
3. Setup, Create and connect your Word Press site to an object storage bucket using Lightsail service.

**Note:** All assignments are mandatory.

### Part B : Elective II : Software Modeling and Architecture

#### Prerequisite Courses, if any:
Object Oriented Programming (210243), Software Engineering (210253)

#### Companion Course, if any: Software Modeling and Architecture

#### Course Objectives:
- To understand Software Modeling and Architecture
- To use tools and techniques of Software Modeling and Architecture
- To design and develop applications using UML
- To apply the knowledge of Software Modeling and Architecture for problem solving

#### Course Outcomes:
- On completion of the course, learner will be able to—
  - **CO1:** Use tools and techniques of Software Modeling and Architecture
  - **CO2:** Apply the knowledge of Software Modeling and Architecture for problem solving
  - **CO3:** Design and develop applications using UML

#### List of Assignments

Select a moderately complex system which has at least 4-5 major functionalities. Identify stakeholders. Actors and write a detailed problem statement for your system. Implement following scenarios by taking reference of design model implementation using suitable object-oriented language.

1. Prepare Use Case Model
2. Draw detail use case diagram using UML 2.0 notations
3. Draw activity diagram with swim lanes using UML 2.0 Notations for major Use Cases
4. Prepare analysis model-class model
5. Draw sequence diagram for every scenario by using advanced notations using UML 2.0 (Identify at least 5 major scenarios (sequence flow) for your system)
6. Prepare Object Diagram, Package Diagram, Component diagram, Development diagram
7. Specify and document the architecture and design pattern with the help of templates. Implement the system features and judge the benefits of the design patterns accommodated.

#### Learning Resources

**Text Books:**

**References Books:**

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http://collegecirculars.unipune.ac.in/sites/documents/Syllabus2022/Forms/AllItems.aspx

e-Books:

MOOC Courses:

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</table>
Prerequisite Courses: Internet Technologies

Course Objectives:
- To understand the importance of digital marketing
- To understand the social media marketing
- To understand the effective marketing strategies and ways

Course Outcomes:
On completion of the course, learner will be able to—
- **CO1**: Understand the importance and fundamentals of digital marketing
- **CO2**: Understand how the social media can be used for marketing
- **CO3**: Analyze the effectiveness of digital marketing and social media over traditional process

Course Contents
1. Why you want to go digital?
2. Introduction to digital marketing
3. Content creation and sharing: Modern Website Creation
4. Digital privacy and Data security
5. Social media marketing
6. Email marketing
7. Online advertising
8. Mobile marketing
9. Web analytics for optimization

Learning Resources

Reference Books:

e-Books: --

MOOC Courses: --

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Prerequisite: General awareness of environment and natural resources of energy

Course Objectives:
- To understand the importance of sustainable energy systems development
- To create awareness about renewable energy sources and technology
- To learn about adequate inputs on a variety of issues in harnessing renewable energy
- To recognize current and possible future role

Course Outcomes:
On completion of the course, learner will be able to—
- CO1: Understand the importance of Sustainable Energy Systems
- CO2: Develop the awareness towards Sustainable Energy Systems protection
- CO3: Know different types of natural resource pollution
- CO4: Develop the awareness towards the exploitation and utilization of conventional and non-conventional energy resources

Course Contents
1. Energy resources and their utilization: Conservation and forms of energy, Electric energy from conventional sources, Renewable energy sources
2. Environmental aspects of electric energy generation: Atmospheric pollution, Thermal pollution, Disposal of waste, Global environmental awareness, Impact of renewable energy generation on environment
4. Wind Energy: Power in the Wind, Wind characteristics, Types of Wind Power Plants (WPPs), Components of WPPs, and Working of WPPs.

Learning Resources

Reference Books:

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http://collegecirculars.unipune.ac.in/sites/documents/Syllabus2022/Forms/AllItems.aspx
Prerequisite: General awareness of communication and relationship

Course Objectives:
- To create awareness about importance of personality development
- To improve soft skills and communication skills
- To develop interpersonal skills and ability to work effectively in a team
- To create awareness about importance of body language to reveal inner self and personality
- To develop professionals with leadership qualities

Course Outcomes:
On completion of the course, learner will be able to—
- CO1: Explore as an individual as well as a team member
- CO2: Express effectively through communication and improve interpersonal skills
- CO3: Develop effective team leadership abilities
- CO4: Work effectively in heterogeneous teams through the knowledge of teamwork, interpersonal skills and leadership qualities

Course Contents
1. Personality Development: A Must for Leadership and Career Growth
   Personality Analysis, Swami Vivekananda’s Concept of Personality Development: Physical Self, Energy Self, Intellectual Self, Mental Self, Blissful Self; Interpersonal Skills: Resolving Conflict, A Smiling Face, Appreciative Attitude, Assertive Nature, Communication Skills, Listening Skills, Developing Empathy; The Personality Attribute of Taking Bold Decisions; Personality Types and Leadership Qualities: Mapping the Different Personality Types, Perfectionists, Helpers, Achievers, Romantics, Observers, Questioners, Enthusiasts or Adventurers, Bosses or Asserters, Mediators or Peacemakers

2. Soft Skills: Demanded by Every Employer
   Change in Today’s Workplace: Soft Skills as a Competitive Weapon, Classification of Soft Skills: Time Management, Attitude, Responsibility, Ethics, Integrity, Values, and Trust, Self-confidence and Courage, Consistency and Predictability, Teamwork and Interpersonal Skills, Communication and Networking, Empathy and Listening Skills, Problem Solving, Troubleshooting and Speed-reading and Leadership

3. Communication Skills
   Speaking Skills, Phonetics, Accent, Intonation, Writing Skill to Create an Impression: Your Résumé or Curriculum Vitae, Writing a Modern Résumé

4. Group Discussion: A Test of Your Soft Skills
   Ability to Work as a Team, Communication Skills, Including Active Listening, Non-verbal Communication, Leadership and Assertiveness, Reasoning, Ability to Influence, Innovation, Creativity and Lateral Thinking, Flexibility

5. Job Interviews: Gateway to the Job Market
   Types of Interviews, Abide by the Dress Code, Importance of Body Language in Interviews, Telephonic or Video Interview—A Growing Trend

6. Body Language: Reveals Your Inner Self and Personality
   Emotions Displayed by Body Language: Aggressive, Submissive, Attentive, Nervous, Upset, Bored, Relaxed, Power, Defensive; Handshake—The Most Common Body Language, Eyes—A Powerful Reflection of One’s Inner Self

Learning Resources
Reference Books:

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Third Year of Artificial Intelligence and Data Science (2019 Course)

Prerequisite Courses: We recommend that candidates should have previously completed AC3-V(217527-V), AC4-V (217535-V) and AC5-IV (317531)

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, learner 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;

Learning Resources

Reference Books:

e-Books:

MOOC Courses:

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Curriculum for Third Year of Artificial Intelligence and Data Science (2019 Course), Savitribai Phule Pune University

Savitribai Phule Pune University
Third Year of Artificial Intelligence and Data Science (2019 Course)
317537(E): Audit Course
AC6-E: MOOC- Learn New Skills

Prerequisite Courses, if any:

Companion Course, if any:

Course Objectives:
- To promote interactive user forums to support community interactions among students, professors, and experts
- To promote students to learn additional skills anytime and anywhere
- To enhance teaching and learning on campus and online
- To motivate students for self-learning useful for advancing their career

Course Outcomes:
CO1: On completion of the course, learner will acquire additional knowledge and skill.

Course Contents

MOOCs (Massive Open Online Courses) provide affordable and flexible way to learn new skills, pursue lifelong interests and deliver quality educational experiences at scale. It helps you to learn for yourself, to advance your career or leverage online courses to educate your workforce. Platforms such as SWAYAM, NPTEL, edx or similar ones can help for self-learning.

World's largest SWAYAM MOOCs is a new paradigm of education for anyone, anywhere, anytime, as per your convenience. It aims to provide digital education free of cost and facilitate hosting of all the interactive courses prepared by more than 1000 specially chosen the best faculty and teachers in the country. SWAYAM MOOCs enhance active learning for improving lifelong learning skills by providing easy access to global resources.

SWAYAM is a programme initiated by Government of India and designed to achieve the three cardinal principles of Education Policy viz., access, equity and quality. The objective of this effort is to take the best teaching learning resources to all, including the most disadvantaged. SWAYAM seeks to bridge the digital divide for students who have remained untouched so far by the digital revolution and have not been able to join the mainstream of the knowledge economy.

This is done through an indigenous developed IT platform that facilitates hosting of all the courses, taught in classrooms from 9th class till post-graduation to be accessed by anyone, anywhere, at any time. All the courses are interactive, prepared by the best teachers in the country and are available, free of cost to the residents in India. More than 1,000 specially chosen faculty and teachers from across the Country have participated in preparing these courses.

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

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

Learning Resources

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

MOOC Courses:

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*Mapping will vary according to the course selected.

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Acknowledgement

It is with great pleasure and honor that I share the curriculum for Third Year of Artificial Intelligence and Data Science (2019 Course) on behalf of Board of Studies (BoS), Computer Engineering. We, members of BoS are giving our best to streamline the processes and curricula design at both UG and PG programs.

It is always the strenuous task to balance the curriculum with the blend of core courses, current developments and courses to understand social and human values. By considering all the aspects with adequate prudence the contents are designed satisfying most of the necessities as per AICTE guidelines and to make the graduate competent enough as far as employability is concerned. I sincerely thank all the minds and hands who work adroitly to materialize these tasks. I really appreciate everyone’s contribution and suggestions in finalizing the contents.

Success is sweet. But it’s sweeter when it’s achieved thorough co-ordination, cooperation and collaboration. I am overwhelmed and I feel very fortunate to be working with such a fabulous team- the Members of Board of Studies, Computer Engineering!

Even in these anxious situations, during the time of this unfortunate pandemic, each and every person, including the course coordinators and their team members, have worked seamlessly to come up with this all-inclusive curriculum for Third Year of Artificial Intelligence and Data Science.

Thank you to all of you for delivering such great teamwork. I don’t think it would have been possible to achieve the goal without each and every one of your efforts! I would like to express my deep gratitude to Dr. Prashant M. Yawalkar (MET’s Institute of Engineering, Nashik), member BoS, Computer Engineering, for coordinating the complete activity and getting it to completion in a smooth manner.

I deeply appreciate and thank the managements of various colleges affiliated to SPPU for helping us in this work. These colleges have helped us by arranging sessions for preliminary discussion in the initial stage and at the same time in conducting Faculty Development Programs for various courses of the revised curriculum. All your support is warmly appreciated.

I sincerely appreciate, the hard work put in by the course coordinators and their team members, without your intellectual work and creative mind, and it would have not been possible to complete this draft. You have been a valuable member of our team!

Special thanks are due to Mr. Vijay Kharat for his efforts in assembling the draft. I would like to thank you from the core of my heart. Thank you for always being your best selves and contributing to the work.

I am thankful to Dr. S. V. Gumaste and Dr. Swati Bhavsar for the time they have spent in critically reading the draft and giving the final touches. I appreciate their initiative and thank them for the time, patience and hard work!

Thank you all, for not only your good work but also for all the support you have given each other throughout the drafting process, that’s what makes the team stronger! You took the meaning of teamwork to a whole new level.

Thank you for all your efforts!

Professor (Mrs.) Dr. Varsha H. Patil, Chairman, and
Members- Dr. Shirish Sane, Dr. Sunil Bhirud, Dr. Manik Dhore, Dr. Pramod Patil, Dr. Girish Khilari, Dr. Sachin Lodha, Dr. Parikshit Mahalle, Dr. Venkateshwaran, Dr. Geetanjali Kale, Dr. Suhasini Itkar, Dr. R. V. Patil, Dr. P. M. Yawalkar and Dr. Swati Bhavsar.
**Task Force at Curriculum Design**

1. **Advisors, the Team of Board of Studies**
   - Dr. Varsha Patil (Chairman), Dr. Shirish Sane, Dr. Sunil Bhirud, Dr. Manik Dhore, Dr. Girish Khilari, Dr. Sachin Lodha, Dr. Parikshit Mahalle, Dr. Pramod Patil, Dr. Venkateshwaran, Dr. Geetanjali Kale, Dr. Suhasini Itkar, Dr. R. V. Patil, Dr. P. M. Yawalkar and Dr. Swati Bhavsar.

2. **Team Leader** - Dr. Prashant M. Yawalkar

3. **Teams, Course Design**

<table>
<thead>
<tr>
<th>Name of Course</th>
<th>Team Coordinator</th>
<th>Team Members</th>
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<tr>
<td>Database Management Systems</td>
<td>Dr. Anuradha Thakare</td>
<td>Prof. Rahul Patil, Prof. Prashant Ahire, Dr. Sharmila Wagh</td>
</tr>
<tr>
<td>Computer Networks</td>
<td>Dr. Amol Potgantwar</td>
<td>Dr. A. V. Dhume, Dr. Vinod V. Kimbahune, Poonam Patil</td>
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<tr>
<td>Web Technology</td>
<td>Prof. Abhijit D. Jadhav</td>
<td>Mr. Avinash Patil, Mr. Saikrishna Mamidishetty</td>
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<tr>
<td>Artificial Intelligence</td>
<td>Dr. J. R. Prasad</td>
<td>Dr. K Rajeswari, Dr. Mrs. Madhuri Potey</td>
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<tr>
<td>Elective I: Embedded Systems and Security</td>
<td>Dr. R. K Agrawal</td>
<td>Dr. Sandeep Chaware, Santosh Kumar, Sayali Belhe</td>
</tr>
<tr>
<td>Elective I: Human Computer Interface</td>
<td>Dr. S. D. Babar</td>
<td>Prof. S. A. Thanekar, Dr. Deepak Dharrao, Dr. Ganesh Bhutkar, Mr. Himmat Sankhala</td>
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<td>Elective I: Pattern Recognition</td>
<td>Dr. S. A. Sonkar</td>
<td>Dr. Swati A. Bhavsar, Dr. Sonali Patil, Dr. Rachna Somkunwar, Mr. Vijay Bahiraji</td>
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<td>Dr. K. S. Wagh</td>
<td>Dr. S. K. Pathan, Dr. Amol Dhumne</td>
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<td>Prof V. D. Dabhade</td>
<td>Prof V. D. Patil</td>
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<td>CN Laboratory</td>
<td>Dr. Amol Potgantwar</td>
<td>Tushar Kute (Industry)</td>
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<tr>
<td>Elective I Laboratory</td>
<td>Dr. N. A. Deshpande</td>
<td>Dr. S. K. Sonkar, Dr. Swati Bhavsar, Shwetali Patil</td>
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<td>Seminar and Technical Communication</td>
<td>Prof Shailendra Vidhate</td>
<td>Mr. Rushikesh Jadhav, Mr. Manoj Suri</td>
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<td>Dr. Sandeep Patil</td>
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<td>Software Laboratory-II</td>
<td>Suvarna Patil, Dr. Shraddha Pandit, S. G. Rathod</td>
<td>Swapnil Chaudhari, Yogesh Murumkar</td>
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<td>Software Laboratory III</td>
<td>Sneha Salvekar, Dr. D. V. Patil, D. J. Bonde</td>
<td>Dr. Mahesh Sanghvi</td>
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<td>Dr. M. A. Jawale, Dr. Swapnaja Ubale N. V. Sharma</td>
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