Curriculum
for

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

(With effect from 2022-23)

http://unipune.ac.in

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:

1. **http://collegecirculars.unipune.ac.in/sites/documents/Syllabus%202019/Rules%20and%20Regulations%20F.E.%202019%20Patt_10.012020.pdf**
2. **http://collegecirculars.unipune.ac.in/sites/documents/Syllabus%202019/First%20Year%20Engineering%202019%20Patt.Syllabus_05.072019.pdf**
3. http://collegecirculars.unipune.ac.in/sites/documents/Syllabus2021/SE_AI-DS_Curriculam_2021_28.06.2021.pdf

Savitribai Phule Pune University

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

(With effect from Academic Year 2022-23)

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Savitribai Phule Pune University
Bachelor of Artificial Intelligence and Data Science

Program Outcomes (POs)

Learners are expected to know and be able to–

PO1	**Engineering knowledge**	Apply the knowledge of mathematics, science, Engineering fundamentals, and an Engineering specialization to the solution of complex Engineering problems.
PO2	**Problem analysis**	Identify, formulate, review research literature and analyze complex Engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and Engineering sciences.
PO3	**Design / Development of Solutions**	Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations.
PO4	**Conduct Investigations of Complex Problems**	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern Tool Usage**	Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modeling to complex Engineering activities with an understanding of the limitations.
PO6	**The Engineer and Society**	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practices.
PO7	**Environment and Sustainability**	Understand the impact of the professional Engineering solutions in societal and Environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics**	Apply ethical principles and commit to professional ethics and responsibilities and norms of Engineering practice.
PO9	**Individual and Team Work**	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication Skills**	Communicate effectively on complex Engineering activities with the Engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project Management and Finance**	Demonstrate knowledge and understanding of Engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary Environments.
PO12	**Life-long Learning**	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSO)

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

PSO1	**Professional Skills**-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.
PSO2	**Problem-Solving Skills**- The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver a quality product for business success.
PSO3	**Successful Career and Entrepreneurship**- The ability to employ modern computer languages, environments and platforms in creating innovative career paths to be an entrepreneur and to have a zest for higher studies.

Savitribai Phule Pune University

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

(With effect from Academic Year 2022-23)

Semester-V

Course Code	Course Name	Teaching Scheme (Hours/Week)			Examination Scheme and Marks						Credit Scheme			
		Lecture	Practical	Tutorial	Mid-Sem	End-Sem	Term work	Practical	Oral	Total	Lecture	Practical	Tutorial	Total
310241	Data Base Management System	03	-	-	30	70	-	-	-	100	03	--	-	03
317521	Computer Networks	03	-	-	30	70	-	-	-	100	03	-	-	03
310252	Web Technology	03	-	-	30	70	-	-	-	100	03	-	-	03
310253	Artificial Intelligence	03	-	-	30	70	-	-	-	100	03	-	-	03
**	Elective I	03	-	-	30	70	-	-	-	100	03	-	-	03
317523	Software Laboratory I	-	04	-	-	-	25	25	-	50	-	02	-	02
317524	CN Laboratory	-	02	-	-	-	25	25	-	50	-	01	-	01
317525	Elective I Laboratory	-	02	-	-	-	25	-	25	50	-	01	-	01
317526	Seminar and Technical Communication	-		01	-	-	25	-	-	25	-	-	01	01
317527	Environmental Studies	-	-	01	-	-	25	-	-	25	-	-	01	01
	Total	**15**	**08**	**02**	**150**	**350**	**125**	**50**	**25**	**700**	**15**	**04**	**02**	**21**
317528	Audit Course 5										**Grade**			
									Total		**15**	**04**	**02**	**21**

**** Elective-I Options**	**Audit Course 5 Options**
317522 (A)Embedded Systems & Security	317528(A) Emotional Intelligence
314445 (C)Design Thinking	317528(B) Industrial Safety And Environment Consciousness
317522 (B)Pattern Recognition	317528(C) 3D Printing
310245 (B) Human Computer Interface	317528(D) Foreign Language
	317528(E) MOOC- Learn New Skills
Software Laboratory I (**Assignments from)**	Data Base Management System and Artificial Intelligence

Savitribai Phule Pune University

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

(With effect from Academic Year 2022-23)

Semester-VI

Course Code	Course Name	Teaching Scheme ##(Hours/Week)			Examination Scheme and Marks						Credit Scheme			
		#Lecture	Practical	Tutorial	Mid-Sem	End-Sem	Term work	Practical	Oral	Total	Lecture	Practical	Tutorial	Total
317529	Data Science	04	-	-	30	70	-	-	-	100	03	--	-	03
317530	Cyber security	04	-	-	30	70	-	-	-	100	03	-	-	03
317531	Artificial Neural Network	04	-	-	30	70	-	-	-	100	03	-	-	03
**	Elective II	04	-	-	30	70	-	-	-	100	03	-	-	03
317533	Software Laboratory II	-	04	-	-	-	25	25	-	50	-	02	-	02
317534	Software Laboratory III	-	04	-	-	-	50	25	-	75	-	02	-	02
317535	Internship**	-	--	-	-	-	50	-	50	100	-	04	-	04
317536	**Mini Project (CS and Elective-II)**	-	02	-	-	-	50	-	25	75	-	01	-	01
	Total	**16**	**10**	**-**	**120**	**280**	**175**	**50**	**75**	**700**	**12**	**09**	**-**	**21**
317537	Audit Course 6										**Grade**			
										Total	**12**	**09**	**-**	**21**

Elective-II Options	**Audit Course 6 Options**
317532(A) Robotics and Automation	317537(A) Digital and Social Media Marketing
317532(B) Natural Language Processing	317537(B) Sustainable Energy Systems
310254(C) Cloud Computing	317537(C) Leadership and Personality Development
310254(D)Software Modeling and Architecture	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**	Internshipguidelines are provided in course curriculum sheet.

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

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

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 mappingsmatrix** justifies the motives, accomplishment and prospect behind learning the course. The Course Objectives, Course Outcomes and CO-PO Mapping Matrix are provided for reference and these are indicative only. The course instructor may modify them as per his or her perspective.

2. @:**CO and PO Mapping Matrix**(Course Outcomes and Program Outcomes)- The **expected** attainment mapping matrix at end of course contents, indicates the correlation levels of 3, 2, 1 and '-'. The notation of 3, 2 and 1 denotes substantially (high), moderately (medium) and slightly (low). The mark '-' indicates that there is no correlation between the respective CO and PO.

3. #:**Elaborated examples/Case Studies**- For each course, contents are divided into six units-I, II, III, IV, V and VI. Elaborated examples/Case Studies are included at the end of each unit to explore how the learned topics apply to real world situations and need to be explored 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]

Note: For Examination rules, pattern and assessment please refer[1]

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

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

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

Semester V

Savitribai Phule Pune University
Third Year of Artificial Intelligence and Data Science (2019 Cou
310241: Database Management Systems

Home

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

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

Companion Course: **Software LaboratoryI**(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

Unit I	Introduction to Database Management Systems and ER Model	06 Hours

Introduction, Purpose of Database Systems, Database-System Applications, View of Data, Database Languages, Database System Structure, Data Models. **Database Design and ER Model**: Entity, Attributes, Relationships, Constraints, Keys, Design Process, Entity-Relationship Model, ER Diagram, Design Issues, Extended E-R Features, converting ER and EER diagram into tables.

#Exemplar/Case Studies	Analyze and design database using ER Model for any real-time application and convert the same into tables.
***Mapping of Course Outcomes for Unit I**	CO1

Unit II	SQL and PL/SQL	07 Hours

SQL: Characteristics and Advantages, SQL Data Types and Literals, DDL, DML, DCL, TCL, SQL Operators. **Tables**: Creating, Modifying, Deleting, Updating.**SQL DML Queries**: SELECT Query and clauses, Index and Sequence in SQL. **Views**: Creating, Dropping, Updating using Indexes, Set Operations, Predicates and Joins, Set membership, Tuple Variables, Set comparison, Ordering of Tuples, Aggregate Functions, SQL Functions, Nested Queries.**PL/SQL**: Concept of Stored Procedures and Functions, Cursors, Triggers, Assertions, Roles and Privileges.

#Exemplar/Case Studies	Implementation of Unit 1 case study using SQL and PL/SQL.
***Mapping of Course Outcomes for Unit II**	CO1, CO2

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

Learning Resources

Text Books :

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

Reference Books :

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

e-Books :

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

MOOCs Courses Links:

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

@ The CO-PO Mapping Matrix

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

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

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

Prerequisite Courses, if any:

Companion Course, if any: **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: Implementclient-server applications using sockets

CO5: Illustrate role of application layer with its protocols, client-server architectures

CO6: Summarizeconcepts of MAC and ethernet.

Course Contents

Unit I	Fundamentals of Computer Network	(06 Hours)

Definition, uses of computer network, **Network Devices**: Bridge, Switch, Router, Gateway, Access Point, **Network Topologies:** Bus, Star, Ring, Tree, Mesh, Hybrid**, Types of Network:** LAN, MAN, WAN, PAN, Ad-Hoc Network, Networks Software, Protocol, Design issues for the Network layers. **Types of Transmission Media:** Guided Media, Unguided Media. **Network Architecture:** Client-Server, Peer To Peer, Hybrid. **Network Models:** OSI and TCP/IP Model, **Types of Addressing:** Physical addressing, Logical addressing, Port addressing and other addressing.

#Exemplar/Case Studies	**Demonstrate the LAN Network**
Mapping of Course Outcomes for Unit I	CO1

Unit II	Physical Layer	(7 Hours)

Functions of Physical Layer, Data And Signals, Digital Transmission, Analog Transmission, **Transmission Impairment**: Attenuation, Distortion, Noise, **Bandwidth utilization**: **Multiplexing** : Frequency-Division Multiplexing , Wavelength Division, synchronous time-division multiplexing, statistical time-division multiplexing. **Spread Spectrum**: Frequency Hopping (FHSS) and Direct Sequence Spread Spectrum (DSSS), Switching: circuit switching, packet switching, message switching, **Types of cable connection**: Straight through connection, Cross over Connection. **Line Coding Schemes:** Manchester and Differential Manchester Encodings.

#Exemplar/Case Studies	**Study of college campus network**
Mapping of Course Outcomes for Unit II	CO2

Unit III	**Network Layer**	**(7 Hours)**

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.

#Exemplar/Case Studies	Simulation of Network Layer Protocol
Mapping of Course Outcomes for Unit III	CO3

Unit IV	**Transport Layer**	**(7 Hours)**

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.

#Exemplar/Case Studies	Simulation of Demonstration of Transport layer protocols.
Mapping of Course Outcomes for Unit IV	CO4

Unit V	**Application Layer**	**(6 Hours)**

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).

#Exemplar/Case Studies	Study of Application Layer protocols using network protocol analyzer. e.g. Wireshark
Mapping of Course Outcomes for Unit V	C05

Unit VI	**Medium Access Control**	**(6 Hours)**

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.

#Exemplar/Case Studies	Study of Medium Access Control protocols
Mapping of Course Outcomes for Unit VI	CO6

Learning Resources

Text Books:

1. Fourauzan B.,"Data Communications and Networking",5th Edition,TataMcGraw-Hill,Publications, ISBN:0–07 – 058408 – 7
2. Andrew S. Tanenbaum, “Computer Networks”, 5th Edition, Pearson India, 2012.
3. Arshdeep Bahga, Vijay Madisetti, “Internet of Things – A hands-on Approach”, Universities Press, ISBN: 0: 0996025510, 13: 978-0996025515
4. Behrouz A. Forouzan, TCP/IP Protocol Suite, McGraw Hill Education, ISBN: 978-0-07-070652-1,
   4th Edition.

Reference Books:

1.L. Peterson and B. Davie, “Computer Networks: A Systems Approach”, 5th Edition, Morgan-Kaufmann, 2012.

2.Kurose, Ross “Computer Networking a Top Down Approach Featuring the Internet”, Pearson, ISBN-10:0132856204

3. Matthew S. G, “802.11 Wireless Networks”, O’Reilly publications, ISBN: 81-7656-992-5

4. C. Siva Ram Murthy and B. S. Manoj, “Ad Hoc Wireless Networks: Architectures and Protocols” Prentice Hall, ISBN-10: 8131706885; ISBN-13: 978-8131706886

5. Holger Karl and Andreas Willing, “Protocols and Architectures for Wireless Sensor Networks”, Wiley India , ISBN: 9788126533695

6. Eldad Perahia, Robert Stacey, “Next Generation Wireless LANs”, Cambridge, ISBN-10: 1107016762;
   ISBN- 13: 978-1107016767

7. Efraim Turban, Linda Volonino, Gregory R. Wood “Computer Networking a Top Down Approach Featuring the In**ternet”, 10th Edition, Wiley; ISBN13: 978-1-118-96126-1**

e-Books:

MOOC Courses:

@ The CO-PO Mapping Table

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO12
CO1	1	1	-	2	1	1	-	-	2	2	-	1
CO2	1	1	-	1	1	1	-	-	2	2	-	1
CO3	2	3	-	2	1	1	-	-	2	2	-	1
CO4	1	1	1	-	1	-	-	-	1	-	1	1
CO5	1	3	-	-	1	-	1	1	-	-	-	-
CO6	1	1	-	2	1	1	-	-	2	2	-	1

Savitribai Phule Pune University
Third Year of Artificial Intelligence and Data Science (2019 Cou
310252: Web Technology

Home

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

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	07 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	07 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	07 Hours

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.

#Exemplar/Case Studies	Develop server-side code for blogging application
***Mapping of Course Outcomes for Unit III**	CO3

Unit IV	**JSP and Web Services**	**07 Hours**

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.

#Exemplar/Case Studies	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
***Mapping of Course Outcomes for Unit IV**	CO3, CO4

Unit V	**Server Side Scripting Languages**	**07 Hours**

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.

#Exemplar/Case Studies	Use of PHP in developing blogging application.
***Mapping of Course Outcomes for Unit V**	CO5, CO6

Unit VI	**Ruby and Rails**	**07 Hours**

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.

#Exemplar/Case Studies	Study of dynamic web product development using ruby and rails
***Mapping of Course Outcomes for Unit VI**	CO6

Learning Resources

Text Books:

1. Jeffrey C.Jackson, "Web Technologies: A Computer Science Perspective", Second Edition, Pearson Education, 2007, ISBN 978-0131856035
2. Robert W. Sebesta," Programming the World Wide Web", 4th Edition, Pearson education, 2008

Reference Books :

1. Marty Hall, Larry Brown, “Core Web Programming", Second Edition, Pearson Education, 2001, ISBN 978-0130897930.
2. H.M. Deitel, P.J. Deitel and A.B. Goldberg, "Internet & World Wide Web How To Program", Third Edition, Pearson Education, 2006, ISBN 978-0131752429.
3. Chris Bates, “Web Programming Building Internet Applications”, 3rd Edition, Wiley India, 2006.
4. Xue Bai et al, “The web Warrior Guide to Web Programming”, Thomson, 2003.

e-Books :

- https://www.w3.org/html/
- HTML, The Complete Reference http://www.htmlref.com/
- http://w3schools.org/
- http://php.net/
- https://jquery.com/
- https://developer.mozilla.org/en-US/docs/AJAX
- http://www.tutorialspoint.com/css/

MOOCs Courses link:

- http://www.nptelvideos.in/2012/11/internet-technologies.html
- https://freevideolectures.com/course/2308/internet-technology/25video lecture by Prof. Indranil Sengupta, IIT, Kharagpur
- https://www.digimat.in/nptel/courses/video/106105191/L01.html
- http://www.nptelvideos.com/php/php_video_tutorials.php

@ The CO-PO Mapping Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO12
CO1	1	1	2	1	1	-	-	-	-	-	-	-
CO2	-	2	1	3	1	-	-	-	1	-	-	-
CO3	2	-	2	1	-	1	-	-	-	-	1	-
CO4	1	3	1	2	2	1	-	1	-	-	-	1
CO5	1	1	2	-	3	-	1	1	-	1	-	-
CO6	2	1	-	2	1	1	-	1	-	-	-	-

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

Home

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

Prerequisites Courses: Programming and Problem solving (110005),
Data Structures and Algorithms (210252)

Companion Course: **SoftwareLaboratory 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

Unit I	Introduction	07 Hours

Introduction to Artificial Intelligence, Foundations of Artificial Intelligence, History of Artificial Intelligence, State of the Art, Risks and Benefits of AI, Intelligent Agents, Agents and Environments, Good Behavior: Concept of Rationality, Nature of Environments, Structure of Agents.

#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

Unit II	Problem-solving	07 Hours

Solving Problems by Searching, Problem-Solving Agents, Example Problems, Search Algorithms, Uninformed Search Strategies, Informed (Heuristic) Search Strategies, Heuristic Functions, Search in Complex Environments, Local Search and Optimization Problems.

#Exemplar/Case Studies	4th Industrial Revolution Using AI, Big Data And Robotics

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

Unit III	**Adversarial Search and Games**	**07 Hours**
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.		
#Exemplar/Case Studies	Machine Learning At Google: The Amazing Use Case Of Becoming A Fully Sustainable Business	
***Mapping of Course Outcomes for Unit III**	CO3, CO4	

Unit IV	**Knowledge**	**07 Hours**
Logical Agents, Knowledge-Based Agents, The Wumpus World, Logic, Propositional Logic: A Very Simple Logic, Propositional Theorem Proving, Effective Propositional Model Checking, Agents Based on Propositional Logic, First-Order Logic, Representation Revisited, Syntax and Semantics of First-Order Logic, Using First-Order Logic, Knowledge Engineering in First-Order Logic.		
#Exemplar/Case Studies	BBC To Launch AI - Enabled Interactive Radio Show For Amazon Echo And Google Home Chat bots	
***Mapping of Course Outcomes for Unit IV**	CO3, CO4	

Unit V	**Reasoning**	**07 Hours**
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		
#Exemplar/Case Studies	The Amazing Ways How Wikipedia Uses Artificial Intelligence	
***Mapping of Course Outcomes for Unit V**	CO4, CO5	

Unit VI	**Planning**	**07 Hours**
Automated Planning, Classical Planning, Algorithms for Classical Planning, Heuristics for Planning, Hierarchical Planning, Planning and Acting in Nondeterministic Domains, Time, Schedules, and Resources, Analysis of Planning Approaches, Limits of AI, Ethics of AI, Future of AI, AI Components, AI Architectures.		
#Exemplar/Case Studies	The Amazing Ways Samsung Is Using Big Data, Artificial Intelligence And Robots To Drive Performance	
***Mapping of Course Outcomes for Unit VI**	CO4, CO6	

Learning Resources

Text Books:

1. Stuart Russell and Peter Norvig, “Artificial Intelligence: A Modern Approach”, Third edition, Pearson, 2003, ISBN :10: 0136042597
2. Deepak Khemani, “A First Course in Artificial Intelligence”, McGraw Hill Education(India), 2013, ISBN : 978-1-25-902998-1
3. Elaine Rich, Kevin Knight and Nair, “Artificial Intelligence”, TMH, ISBN-978-0-07-008770-5

Reference Books:

1. Nilsson Nils J , "Artificial Intelligence: A new Synthesis", Morgan Kaufmann Publishers Inc. San Francisco, CA, ISBN: 978-1-55-860467-4
2. Patrick Henry Winston, "Artificial Intelligence", Addison-Wesley Publishing Company, ISBN: 0-201-53377-4
3. Andries P. Engelbrecht-Computational Intelligence: An Introduction, 2nd Edition-Wiley India- ISBN: 978-0-470-51250-0
4. Dr. Lavika Goel, "Artificial Intelligence: Concepts and Applications", Wiley publication, ISBN: 9788126519934
5. Dr. Nilakshi Jain, "Artificial Intelligence, As per AICTE: Making a System Intelligent", Wiley publication, ISBN: 9788126579945

e-Books :

- https://cs.calvin.edu/courses/cs/344/kvlinden/resources/AIMA-3rd-edition.pdf
- https://www.cin.ufpe.br/~tfl2/artificial-intelligence-modern-approach.9780131038059.25368.pdf
- 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

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

SavitribaiPhule Pune University
Third Year of Artificial Intelligence and Data Science (2019 Course)
Elective I
317522(A): Embedded Systems and Security

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

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

Unit I	Introduction to Embedded Systems	(6 Hours)

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.

#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	**CO 1**

Unit II	ARM Architecture	(8 Hours)

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 & Cortex introduction/features.

#Exemplar/Case Studies	Study any one ARM 7 based development board. Example: STM Nucleo Board/MCB 2140
Mapping of Course Outcomes for Unit II	**CO 2**

Unit III	Embedded Firmware Design and Development	(8 Hours)

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 & user defined functions, Pre-processors and Macros, Programming of ARM 7 GPIO pins & peripherals like Timer, PWM, UART using C, Integration of Hardware & firmware, IDE's for embedded system development, types of file generated on cross compilation, simulators, emulators and debugging.

#Exemplar/Case Studies	Study KEIL or any suitable Embedded Development Tools
Mapping of Course Outcomes for Unit III	**CO3**

Unit IV	**Embedded/Real Time Operating System Concepts**	**(8 Hours)**

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**

Unit V	**Embedded Linux**	**(8 Hours)**

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**

Unit VI	**Embedded Systems Security**	**(6 Hours)**

Security Threats of ES, Side-Channel Analysis Attacks in Embedded System Devices, Network attacks, Software Attacks, Control hijacking attacks, Reverse engineering, Malware, Memory and bus attacks, Cold Boot Attack. Injecting crafted packets or input, Eavesdropping, Brute-force search attacks. Effects of Attack: Denial-of-Service, Code execution, Integrity violation, Financial loss, Degraded level of protection, Security requirements for embedded devices,Challenges of Security Threats of ES, Counter measures.

#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
2. Embedded Systems: An Integrated Approach, Lyla Das, Pearson

Reference Books:

1. Raj Kamal, Embedded Systems – Architecture, Programming and Design, 2nd edition, TMH
2. Jean J.Labrosse, MicroC OS II, The Real-Time Kernel, 2nd edition, CMP Books
3. Chris Simmonds, Mastering Embedded Linux Programming, 2nd edition, Packt Publishing
4. Dr. K V K K Prasad, Embedded/Real Time Systems: Concepts, Design, & Programming, Dreamtech Press, New Delhi
5. Parag H Dave, Himanshu H. Dave, Embedded systems Concepts, design and programming, Pearson India
6. Embedded Systems Security, David Kleidermacher, Mike Kleidermacher
7. Frank Vahid and Tony Givargis, Embedded System Design – A Unified hardware/ Software introduction, 3rd edition, Wiley

e-Books:

1. https://bootlin.com/doc/training/embedded-linux/embedded-linux-slides.pdf
2. https://tec.gov.in/pdf/Studypaper/Embedded%20sytem%20security.pdf

MOOC Courses:

1. Embedded System Design With ARM, By Prof. IndranilSengupta, Prof. Kamalika Dutta, IIT Kharagpur

@The CO-PO mapping table

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

Home

SavitribaiPhule Pune University
Third Year of Artificial Intelligence and Data Science (2019 Course)
Elective I
314445 (C): Design Thinking

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

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

Unit I	INTRODUCTION TO DESIGN THINKING	(06 Hours)

Introduction to Design and Design Thinking, Definition of Design Thinking, Need of Design Thinking, Features of Design Thinking, Problem Solving and Design, Design thinking as Strategy of Innovation, Use of Design Thinking, Design Thinking-Attributes, The Principles of Design Thinking, The Five-step Process of Design Thinking(Empathize, Define, Ideate, Prototype, Test),Design **Thinking-A Solution basedthinking:** Design Thinking vs. Scientific Method, Problem Focused vs. Solution Focused, Analysis vs.Synthesis, Divergent Thinking vs. Convergent Thinking , Roots of Design Thinking in Human Centric Design Process.

#Exemplar/Case Studies	Understanding the Design Thinking Mindsets
Mapping of Course Outcomes for Unit I	**CO1**

Unit II	EXPLORE AND EMPATHIZE	(06 Hours)

Explore- STEEP Analysis, Activity Systems, Stakeholder Analysis, Framed Opportunities
Empathise- Observation, Problem statement, User Interviews- Interview for Empathy, Explorative Interview, Ask 5x Why, 5W+H questions (Design Thinking Toolbox), Needs Finding, Empathy Map,
Persona Development, Customer Journey Map

#Exemplar/Case Studies	Details of Creative Thinking Strategies
Mapping of Course Outcomes for Unit II	CO2

Unit III	DEFINE AND IDEATE	(06 Hours)

Define- Define Point of view, “How might we ...” question, Storytelling, Context MappingIdeate- Brainstorming, 2x2 Matrix
Ideate- Purpose, Methods & Tools, SCAMPER, SCAMPER for Ideation, SCAMPER template, AnalogousInspiration, IDEATION using Deconstruct & Reconstruct, User Experience Journey

#Exemplar/Case Studies	

Mapping of Course Outcomes for Unit III	CO3

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)**

Test- Testing Sheet, Feedback Capture Grid, Powerful questions in experience testing, Solution interview Structured Usability Testing, A/B Testing, Design Testing with Users, Exploring Visual Design Mock-Ups Choosing a Design Testing, Usability Testing, Reflect- I like, I wish, I wonder, Create a pitch, lean canvas lessons learned, Road map for implementation Evolve- Concept Synthesis, Viability Analysis(Impact Evaluation), Innovation Tool using user needs, CAP, 4s.

#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:

1. Michael Lewrick, Patrick Link, Larry Leifer , “The Design Thinking Toolbox: A Guide to Mastering the Most Popular and Valuable Innovation Methods”, March 2020 edition, ISBN: 978-1-119- 62921-4, WILEY Publication.
2. Mr Lee Chong Hwa (Lead Facilitator), “The Design Thinking: Guidebook”

Reference Books:

1. Russ Unger, Carolyn Chandler, “A Project Guide to UX Design For user experience designers in the field or in the making (Voices That Matter)”, 2nd Edition, ISBN 13: 978-0-321-81538-5
2. Karl T Ulrich, “Design – Creation of Artifacts in Society”, 1st edition, ISBN 978-0-9836487-0-3,
University of Pennsylvania
3. Tim Brown, “Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation”, ISBN- 9780061937743, Harper Collins, 2009.
4.Eli Woolery, “Design Thinking Handbook”, In-Vision publisher.
5.Jeanne Liedtka, Andrew King, Kevin Bennett, “Solving Problems with Design Thinking: TenStories
Of “What Works”, Columbia Business School Publishing, E-ISBN 978-0-231-53605-9

e-Books:

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

2. NPTEL: Humanities and Social Sciences - NOC: Understanding Design Thinking & People Centered
Design
3. NPTEL: Management - NOC: Design Thinking - A Primer
4. Design Thinking Transformed Airbnb: https://review.firstround.com/How-design-thinkingtransformed-Airbnb-from-failing-startup-to-billion-dollar-business
5. UberEATS: https://medium.com/uber-design/how-we-design-on-the-ubereats-teamff7c41fffb76
6. IBM Design Thinking: A Framework To Help Teams Continuously Understand and Deliver: https://www.ibm.com/blogs/think/2016/01/ibm-design-thinking-a-framework-for-teams-tocontinuously-understand-and-deliver/

MOOC Courses:

@The CO-PO mapping table

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

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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 Patten 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)

Introduction to statistical pattern recognition, The Gaussian case and class dependance, Discriminant function, Additional Examples, Extensions: Training, Alternative Classification Procedures, Unsupervised Approaches, Classifier Performance, Risk and Errors: Measurement of Classification Performance, General Measures of Classification Risk.

#Exemplar/Case Studies	statistical pattern recognition in image processing
Mapping of Course Outcomes for Unit II	CO2

Unit III	Syntactic Pattern Recognition	(07 Hours)

Overview, Qualifying structure in Pattern Description and Recognition, Grammar-Based Approach and Applications, Elements of Formal Grammars, Examples of String Generation as Pattern Description, Syntactic **Recognition Via Parsing and other Grammars**: -Recognition of Syntactic Descriptions, Parsing, CYK Parsing Algorithm, ATN in Parsing, Higher Dimensional Grammars, Stochastic Grammars and Applications.	
#Exemplar/Case Studies	Block World Description
Mapping of Course Outcomes for Unit III	CO3

Unit IV	**Graphical Approaches & Grammatical Inference in Syntactic Pattern Recognition**	**(07 Hours)**
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.		
#Exemplar/Case Studies	Structural Unification Using Attributed Graphs	
Mapping of Course Outcomes for Unit IV	CO4	

Unit V	**Neural Pattern Recognition**	**(07 Hours)**
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		
#Exemplar/Case Studies	Hardware Realizations of Neural Network	
Mapping of Course Outcomes for Unit V	CO5	

Unit VI	**Feedforward Networks & Unsupervised Learning in Neural Pattern Recognition**	**(07 Hours)**
Multilayer, Feedforward Network Structure, Training the Feedforward Network: The Delta Rule, Generalized Delta Rule(GDR), Extension of the DR for Units in the Hidden layers, Pattern Associator for Character Classification, **Unsupervised Learning in NeurPR: Self organizing Networks:** Introduction, Adaptive Resonance Architectures, Self-Organizing Feature Maps(Kohonen).		
#Exemplar/Case Studies	Examples of Content Addressable Memory Applications in PR:Character Recognition, Relational Constraint Satisfaction(Coloring)	
Mapping of Course Outcomes for Unit VI	**CO6**	

Learning Resources

Text Books:

1. ROBBERT SCHALKOFF, “Pattern Recognition: Statistical, Structural and Neural Approaches”, Willey Publication, ISBN978-81-245-1370-3
2. R.O.Duda, P.E.Hart and D.G.Stork, “Pattern Classification”, John Wiley,ISBN-978-0-471-05669-0

Reference Books:

1. Earl Gose, Richard Johnsonbaugh, Steve Jost, "Pattern Recognition and Image Analysis"
2. Andrew R.Webb, Keith D.Copsey,"Statistical Pattern Recognition",3rd edition Wiely , ISBN:978-0-470-68227-2
3. Christopher M. Bishop,"Neural network for Pattern Recognition," Oxford University Press, ISBN-978-0-19-853864-6

e-Books:

1.http://users.isr.ist.utl.pt/~wurmd/Livros/school/Bishop%20%20Pattern%20Recognition%20And%20Machine%20Learning%20-%20Springer%20%202006.pdf2.2.https://darmanto.akakom.ac.id/pengenalanpola/Pattern%20Recognition%204th%20Ed.%20(2009).pdf

3.https://www.inf.ed.ac.uk/teaching/courses/nlu/assets/reading/Gurney_et_al.pdf

MOOC Courses:

1.https://nptel.ac.in/courses/117105101

2,https://nptel.ac.in/courses/106106046

@The CO-PO mapping table

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

Savitribai Phule Pune University

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

Home

Elective I

310245(B): Human Computer Interface

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

Foundation: Human Memory. **Thinking**: Reasoning and Problem Solving, Emotion, Individual Difference, Psychology and design of Interactive systems, The Computer-Text Entry Device, Positioning, Pointing, Display devices, Devices for virtual reality and 3D Interaction, The Interactions-Models of Interaction, Frameworks and HCI, Ergonomics, Interaction styles, Ergonomics, Elements of WIMP Interface, Interactivity, Measurable Human Factors, The context of Interaction. **Importance of User Interface**: Defining user Interface, Brief History of Human-Computer Interface, Good and Poor Design- Importance of good design.

#Exemplar/Case Studies	Paper prototype – Design elements of GUI
***Mapping of Course Outcomes for Unit I**	CO1,CO6

Unit II	Human Perspective in Interaction Design Process	07 Hours

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

Human control while increasing automation. **Theories**: Design-by-level, Stages of action, Consistency, Contextual Theories, Dynamic theories.	
#Exemplar/Case Studies	Registration form design.
***Mapping of Course Outcomes for Unit II**	CO1,CO2

Unit III	**Interaction Styles and HCI in Software Process**	**07 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.		
#Exemplar/Case Studies	Comparison - GUI and Web design with a real time example.	
***Mapping of Course Outcomes for Unit III**	CO1,CO3,CO5	

Unit IV	**Usability Evaluation and Universal Design**	**07 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.		
#Exemplar/Case Studies	GOMS model - Adding items to a cart of e-shopping website.	
***Mapping of Course Outcomes for Unit IV**	CO1,CO3	

Unit V	**HCI Paradigms**	**07 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.		
#Exemplar/Case Studies	Interface Design- Pattern gesture recognition	
***Mapping of Course Outcomes for Unit V**	CO1,CO3,CO4	

Unit VI	**HCI for Mobile and Handheld devices**	**07 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		

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:

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

Reference Books :

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

e-Books :

- http://www.37steps.com/data/pdf/PRIntro_medium.pdf
- https://www.ecse.rpi.edu/~nagy/PDF_chrono/2005_Zou_Nagy_complexity_05.pdf
- https://www.raywenderlich.com/240-android-accessibility-tutorial-getting-started

MOOCs Courses link

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

@ The CO-PO Mapping Matrix

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

Savitribai Phule Pune University
Thirdd Year of Artificial Intelligence and Data Science (2019 Course)
317523: Software Laboratory I

Home

Teaching Scheme:	Credit	Examination Scheme:
PR: 04 Hours/Week	02	Term Work (TW): 25 Marks Practical(PR): 25 Marks

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 least10 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/SQLcode 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 5per 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.

Learning Resources

Text Books:

1. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", Third edition, Pearson, 2003, ISBN :10: 0136042597
2. Deepak Khemani, "A First Course in Artificial Intelligence", McGraw Hill Education(India), 2013, ISBN : 978-1-25-902998-1
3. Elaine Rich, Kevin Knight and Nair, "Artificial Intelligence", TMH, ISBN - 978-0-07-008770-5
4. SilberschatzA.,KorthH.,SudarshanS.,"DatabaseSystemConcepts",McGrawHillPublishers,ISBN 0-07-120413-X, 6th edition
5. ConnallyT,BeggC., "DatabaseSystems", Pearson Education,ISBN 81-7808-861-4
6. PramodJ.SadalageandMartinFowler,"NoSQLDistilled",AddisonWesley,ISBN-10:0321826620, ISBN-13: 978-0321826626

Reference Books:

1. Nilsson Nils J , "Artificial Intelligence: A new Synthesis", Morgan Kaufmann Publishers Inc. San Francisco, CA, ISBN: 978-1-55-860467-4
2. Patrick Henry Winston, "Artificial Intelligence", Addison-Wesley Publishing Company, ISBN: 0-201-53377-4Andries P. Engelbrecht, "Computational Intelligence: An Introduction", 2nd Edition-Wiley India-ISBN: 978-0-470-51250-0
3. Kristina Chodorow, Michael Dierolf, "MongoDB: The Definitive Guide", O'ReillyPublications,ISBN: 978-1-449-34468-9
4. AdamFowler,"NoSQLForDummies",JohnWiley&Sons,ISBN-1118905628
5. Kevin Roebuck, "Storing and Managing Big Data - NoSQL, HADOOP and More",EmereoptyLimited, ISBN: 1743045743, 9781743045749
6. JoyA.Kreibich,"UsingSQLite",O'REILLY, ISBN:13:978-93-5110-934-1
7. SeemaAcharya,"DemystifyingNoSQL",WileyPublications,ISBN:9788126579969

e-Books:

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

MOOC Courses:

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

@The CO-PO mapping table

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

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 Serve

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.

@The CO-PO mapping table

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

Home

Savitribai Phule Pune University
Third Year of Artificial Intelligence and Data Science (2019 Course)
317525:Elective I Laboratory Embedded Systems and Security

Teaching Scheme:	Credit	Examination Scheme:
PR: 02 Hours/Week	01	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
2. Embedded Systems: An Integrated Approach, Lyla Das, Pearson

Reference Books:

1. Raj Kamal, Embedded Systems – Architecture, Programming and Design, 2nd edition, TMH
2. Jean J. Labrosse, MicroC OS II, The Real-Time Kernel, 2nd edition, CMP Books
3. Chris Simmonds, Mastering Embedded Linux Programming, 2nd edition, Packt Publishing

e-Books:

- https://bootlin.com/doc/training/embedded-linux/embedded-linux-slides.pdf
- https://tec.gov.in/pdf/Studypaper/Embedded%20sytem%20security.pdf

MOOC Courses:

- Embedded System Design With ARM, By Prof. Indranil Sengupta, Prof. Kamalika Dutta, IIT Kharagpur

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

Home

Savitribai Phule Pune University
Third Year of Artificial Intelligence and Data Science (2019 Course)
317525: Elective I Laboratory Design Thinking

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 yoursolution, 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:

1. Michael Lewrick, Patrick Link, Larry Leifer , "The Design Thinking Toolbox: A Guide to Mastering the Most Popular and Valuable Innovation Methods", March 2020 edition, ISBN: 978-1-119-62921-4, WILEY Publication.
2. Mr Lee Chong Hwa (Lead Facilitator), "The Design Thinking: Guidebook"

Reference Books:

1. IDEO (Firm), "The Field Guide to Human-centered Design: Design Kit", 1 st edition, ISBN978099140631-9, IDEO 2015.
2. Jeanne Liedtka, Tim Ogilvie, and Rachel Brozenske, The Designing for Growth Field Book: A Step-by-Step Project Guide (Columbia University Press, 2014)

e-Books:

1. Design Thinking , A guide to Creative problem Solving for Everyone. Andy Pressmanhttps://1lib.in/book/3656420/e95cd0
2. The Design thinking Playbook: Mindful Digital Transformation of Teams, Products , Services, Buisnesses and Ecoystems , Michael Lewrick https://1lib.in/book/3603473/24dab2

MOOC Courses:

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

@The CO-PO mapping table

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

Savitribai Phule Pune University
Third Year of Artificial Intelligence and Data Science (2019 Course)
317525: Elective I Laboratory Pattern Recognition

Home

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

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

Learning Resources

Text Books:

1. ROBBERT SCHALKOFF, “Pattern Recognition: Statistical, Structural and Neural Approaches”, Wiley Publication, ISBN978-81-245-1370-3
2. R.O.Duda, P.E.Hart and D.G.Stork, “Pattern Classification”, John wiley ISBN-978-0-471-05669-0

Reference Books:

1. Earl Gose, Richard Johnsonbaugh, Steve Jost, “Pattern Recognition and Image Analysis”
2. Andrew R.Webb, Keith D.Copsey,”Statistical Pattern Recognition”,3rd edition Wiely , ISBN:978-0-470-68227-2
3. Christopher M. Bishop,”Neural network for Pattern Recognition,” Oxford University Press, ISBN-978-0-19-853864-6

e-Books:

- http://users.isr.ist.utl.pt/~wurmd/Livros/school/Bishop%20%20Pattern%20Recognition%20And%20Machine%20Learning%20-%20Springer%20%202006.pdf
- https://darmanto.akakom.ac.id/pengenalanpola/Pattern%20Recognition%204th%20Ed.%20(2009).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/106106046

@The CO-PO mapping table

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

Home

Savitribai Phule Pune University
Third Year of Artificial Intelligence and Data Science (2019 Course)
317525: Elective I Laboratory Human Computer Interface

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

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 3 D modeling software

Learning Resources

Text Books:

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

- **Reference Books:**

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

e-Books

- http://www.37steps.com/data/pdf/PRIntro_medium.pdf
- https://www.ecse.rpi.edu/~nagy/PDF_chrono/2005_Zou_Nagy_complexity_05.pdf
- https://www.raywenderlich.com/240-android-accessibility-tutorial-getting-started

MOOC Courses:

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

@The CO-PO mapping table

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

Savitribai Phule Pune University
Third Year of Artificial Intelligence and Data Science (2019 Course)
317526: Seminar and Technical Communication

Home

Teaching Scheme	Credit: 01	Examination Scheme and Marks
Tutorial: 01 Hour/Week		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/ …..,Discussions 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 :

1. Rebecca Stott, Cordelia Bryan, Tory Young, "Speaking Your Mind: Oral Presentation and Seminar Skills (Speak-Write Series)", Longman, ISBN-13: 978-0582382435

2. Johnson-Sheehan, Richard, "Technical Communication", Longman. ISBN 0-321-11764-6

3.Vikas Shirodka, "Fundamental skills for building Professionals", SPD, ISBN 978-93-5213-146-5

@The CO-PO Mapping Matrix

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

Savitribai Phule Pune University
Third Year of Artificial Intelligence and Data Science (2019 Course)
317527: Environmental Studies

Home

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

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

Unit I	Introduction to Environmental Pollution	(03 Hours)

Environmental pollution: Environment and its importance, Definition, Types. Effect of environmental pollution on Plants, Non-living things.

Unit II	Water Pollution	(03 Hours)

Water Pollution: Definition, Sources of water Pollution, Types of wastewater-Domestic and industrial wastewater

Unit III	Air Pollution and Noise Pollution	(03 Hours)

Air pollution: Definition, Sources/causes of air pollution. Atmospheric layers, Effects on human.
Noise Pollution: Definition of Noise Pollution, Types of Noise Pollution

Unit IV	E-waste Management and Green computing	(03 Hours)

E-waste management: Definition of E-waste, Sources of E-waste, Types of E-waste
Green computing: Definition, Objectives of Green Computing, Necessity, Environmental benefits

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:

3. "The text book of Environmental studies", Dr. P. D. Raut, Shivaji University, 2013.
4. "A Text Book of Environmental Studies", Dr. D. K. Asthana, S. Chand.
5. "Environmental Pollution, monitoring and control", S. M. Khopkar, New Age Publication.

Reference Books:

4. "Air Pollution", M. N. Rao, McGrawHill, Publication.
5. "E-waste Management and Procurement of Environment", Dr. Suresh Kumar, Authorspress, 2021.
6. "Green Computing Approach towards sustainable development", M. Afshar Alam, Dreamtech Press. 2020.

Web Links:

1. Prof. Mukesh Sharma, IIT Kanpur https://archive.nptel.ac.in/courses/105/102/105102089
2. Prof. J. Bhattacharyya, IIT Kharagpur, https://archive.nptel.ac.in/courses/123/105/123105001
3. Prof. Bhola Ram Gurjar, IIT Roorkee, https://archive.nptel.ac.in/courses/105/107/105107213

e-Books: 1. Bharucha, Erach (2005): "Text Book of Environmental Studies for Undergraduate Courses", University Press (India) pvt ltd, Hyderabad, India
2. Kothari Dr Milind- 2005- Environmental Education- Universal Publication Agra.
3. IGNOU 1995- FST- 1/4 Foundation course in Science and Technology "Environment and Resource" – Indira Gandhi Open University, New Delhi.

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

@The CO-PO mapping table

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

SavitribaiPhule Pune University
Third Year of Artificial Intelligence and Data Science (2019 Course)
317528(A): Audit Course5
AC5-A: Emotional Intelligence

Home

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:

7. Daniel Goleman," Emotional Intelligence – Why It Matters More Than IQ," , Bantam Books, ISBN-10: 055338371X13: 978-0553383713
8. Steven Stein , "The EQ Edge" , Jossey-Bass, ISBN : 978-0-470-68161-9
9. Drew Bird , "The Leader's Guide to Emotional Intelligence" , ISBN: 9781535176002

@The CO-PO mapping table

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

SavitribaiPhule Pune University
Third Year of Artificial Intelligence and Data Science (2019 Course)
317528(B): Audit Course5
AC5-B: Industrial Safety and Consciousness

Home

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

Learning Resources

Books:

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

@The CO-PO mapping table

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

Home

SavitribaiPhule Pune University
Third Year of Artificial Intelligence and Data Science (2019 Course)
317528(C): Audit Course5
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:

1. Richard Horne, Kalani Kirk Hausman, " 3D Printing for Dummies", Taschenbuch, ISBN: 9781119386315
2. Greg Norton, "3D Printing Business - 3D Printing for Beginners - How to 3D Print",ISBN:9781514785669
3. Liza Wallach Kloski and Nick Kloski, " Getting Started with 3D Printing: A Hands-on Guide to the Hardware, Software, and Services Behind the New Manufacturing Revolution", Maker Media, ISBN:1680450204
4. Jeff Heldrich , "3D Printing: Tips on Getting Started with 3D Printing to Help you make Passive income for your Business"

@The CO-PO mapping table

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	1	-	1	1	1	1	-	-	1	-
CO2	-	1	1	1	1	-	-	-	-	-	1	-
CO3	-	1	1	1	1	1	-	1	-	-	1	1

SavitribaiPhule Pune University
Third Year of Artificial Intelligence and Data Science (2019 Course)
317528(D): Audit Course5
AC5-D: Foreign Language(Japanese Module 3)

Home

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 Japaneselanguage.
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

References:

1. Minna No Nihongo, ―Japanese for Everyone, Elementary Main Text book 1-1 (Indian Edition), Goyal Publishers & Distributors Pvt. Ltd.
2. http://www.tcs.com (http://www.tcs.com/news_events/press_releases/Pages/TCS-InauguratesJapan-centric-Delivery-Center-Pune.aspx)

@The CO-PO mapping table

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

SavitribaiPhule Pune University
Third Year of Artificial Intelligence and Data Science (2019 Course)
317528(E): Audit Course5
AC5-E: MOOC- Learn New Skills

Home

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 learnfor 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 9^{th}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.

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												

Semester VI

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Home

Savitribai Phule Pune University
Third Year of Artificial Intelligence and Data Science (2019 Course)
317529: Data Science

Teaching Scheme:	Credit	Examination Scheme:
TH: 04 Hours/Week##	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 pre-processing 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)**
Introduction, Data Analytic Lifecycle: Introduction, Phase 1: Discovery, Phase 2: Data Preparation, Phase 3: Model Planning, Phase 4: Model Building, Phase 5: Communication results, Phase 6: Operationalize.		
#Exemplar/Case Studies	Case study: Global Innovation Social Network and Analysis (GINA).	

Mapping of Course Outcomes for Unit III	CO3	
Unit IV	**Predictive Data Analytics with Python**	**(7 Hours)**
Introduction, Essential Python Libraries, Basic examples. Data Preprocessing: Removing Duplicates, Transformation of Data using function or mapping, replacing values, Handling Missing Data. Analytics Types: Predictive, Descriptive and Prescriptive. Association Rules: Apriori Algorithm, FP growth. Regression: Linear Regression, Logistic Regression. Classification: Naïve Bayes, Decision Trees. Introduction to Scikit-learn, Installations, Dataset, mat plotlib, filling missing values, Regression and Classification using Scikit-learn.		
#Exemplar/Case Studies	Use IRIS dataset from Scikit and apply data preprocessing methods	
Mapping of Course Outcomes for Unit IV	CO4,CO2	
Unit V	**Data Analytics and Model Evaluation**	**(7Hours)**
Clustering Algorithms: K-Means, Hierarchical Clustering, Time-series analysis. Introduction to Text Analysis: Text-preprocessing, Bag of words, TF-IDF and topics. Need and Introduction to social network analysis, Introduction to business analysis. Model Evaluation and Selection: Metrics for Evaluating Classifier Performance, Holdout Method and Random Sub sampling, Parameter Tuning and Optimization, Result Interpretation, Clustering and Time-series analysis using Scikit- learn, sklearn. metrics, Confusion matrix, AUC-ROC Curves, Elbow plot.		
#Exemplar/Case Studies	Use IRIS dataset from Scikit and apply K-means clustering methods	
Mapping of Course Outcomes for Unit V	CO4, CO2	
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	

Learning Resources

Text Books:

1. David Dietrich, Barry Hiller, “Data Science and Big Data Analytics”, EMC education services, Wiley publication, 2012, ISBN0-07-120413-X.
2. Jiawei Han, Micheline Kamber, and Jian Pie, “Data Mining: Concepts and Techniques” Elsevier Publishers Third Edition, ISBN: 9780123814791, 9780123814807.

Reference Books:

1. EMC Education Services, “Data Science and Big Data Analytics- Discovering, analyzing Visualizing and Presenting Data” Ist Edition.
2. DT Editorial Services, “Big Data, Black Book”, DT Editorial Services, ISBN: 9789351197577, 2016 Edition.
3. Chirag Shah, “A Hands-On Introduction To Data Science”, Cambridge University Press, (2020), ISBN : ISBN 978-1-108-47244-9.
4. Wes McKinney, “Python for Data Analysis ”, O' Reilly media, ISBN: 978-1-449-31979-3.
5. Trent Hauk, “Scikit-learn Cookbook”, Packt Publishing, ISBN: 9781787286382.
6. Jenny Kim, Benjamin Bengfort, “Data Analytics with Hadoop”, OReilly Media, Inc., ISBN: 9781491913703

7. Venkat Ankam,"Big Data Analytics", Packt Publishing, ISBN: 9781785884696.
8. Seema Acharya, Subhashini Chellappan, "Big Data And Analytics", Wiley publication, ISBN: 9788126579518.

e-Books:

1. An Introduction to Statistical Learning by Gareth James https://www.ime.unicamp.br/~dias/Intoduction%20to%20Statistical%20Learning.pdf
2. Python Data Science Handbook by Jake VanderPlas https://tanthiamhuat.files.wordpress.com/2018/04/pythondatasciencehandbook.pdf
3. Hadoop Tutorial : https://www.tutorialspoint.com/hadoop/hadoop_tutorial.pdf?utm_source=7_&utm_medium=affiliate&utm_content=5f34cd37cdf1050001b09537&utm_campaign=Admitad&utm_term=761c575424fc4a6b48d02f72157eb578
4. Learning with Python; How to think like a computer scientist: http://openbookproject.net/thinkcs/python/english3e/
5. Scikit Learn Tutorial https://scikit-learn.org/stable/
6. Python for everybody:http://do1.dr-chuck.com/pythonlearn/EN_us/pythonlearn.pdf
7. An introduction to data Science : 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
4. Computer Science and Engineering - NOC:Big Data Computing
5. Big Data Computing - Course

@The CO-PO mapping table

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

Home

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

Unit I	Introduction	(06 Hours)

Introduction, Elements of Information Security, Security Policy, Techniques, Steps, Categories, Operational Model of Network Security, Basic Terminologies in Network Security. Threats and Vulnerability, Difference between Security and Privacy.

#Exemplar/Case Studies	**Case study on cyber attacks**
Mapping of Course Outcomes for Unit I	C01, C02

Unit II	Data Encryption Techniques And Standards	(08 Hours)

Introduction, Encryption Methods: Symmetric, Asymmetric, Cryptography, Substitution Ciphers. Transposition Ciphers, Stenography applications and limitations, Block Ciphers and methods of operations, Feistal Cipher, Data Encryption Standard (DES), Triple DES, Weak Keys in DES Algorithms, Advance Encryption Standard (AES).

#Exemplar/Case Studies	Symmetric encryption algorithm case study
Mapping of Course Outcomes for Unit II	C03, C04

Unit III	Public Key And Management	(08 Hours)

Public Key Cryptography, RSA Algorithm: Working, Key length, Security, Key Distribution, Deffie-Hellman Key Exchange, Elliptic Curve: Arithmetic, Cryptography, Security, Authentication methods, Message Digest, Kerberos, X.509 Authentication service. Digital Signatures: Implementation, Algorithms, Standards (DSS), Authentication Protocol.

#Exemplar/Case	Public encryption algorithm case study

Studies	
Mapping of Course Outcomes for Unit III	C03, C04

Unit IV	**Security Requirements**	**(08 Hours)**

IP Security: Introduction, Architecture, IPV6, IPv4, IPSec protocols, and Operations, AH Protocol, ESP Protocol, ISAKMP Protocol, VPN. WEB Security: Introduction, Secure Socket Layer (SSL), SSL Session and Connection, SSL Record Protocol, Change Cipher Spec Protocol, Alert Protocol, Handshake Protocol. Electronic Mail Security: Introduction, Pretty Good Privacy, MIME, S/MIME, Comparison. Secure Electronic Transaction (SET).

#Exemplar/Case Studies	Cisco Security case study
Mapping of Course Outcomes for Unit IV	C03, C04

Unit V	**Firewall And Intrusion**	**(08 Hours)**

Introduction, Computer Intrusions. Firewall Introduction, Characteristics and types, Benefits and limitations. Firewall architecture, Trusted Systems, Access Control. Intrusion detection, IDS: Need, Methods, Types of IDS, Password Management, Limitations and Challenges.

#Exemplar/Case Studies	Firewall And Intrusion case study
Mapping of Course Outcomes for Unit V	C03, C04

Unit VI	**Cyber Forensic, Hacking& its countermeasures**	**(08 Hours)**

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

#Exemplar/Case Studies	Cyber Forensics, ethical hacking case study
Mapping of Course Outcomes for Unit VI	C03, C04

Learning Resources

Text Books:

6. Dr. V.K. Pachghare, Cryptography and Information Security, PHI, ISBN 978-81-303-5082-3
7. Nina Godbole,SunitBelapure, Cyber Security,Wiley India, ISBN:978-81-345-2179-1
8. PDF Digital Content : Stuart McCLURE, Joel Scambray, George Kurtz, Hacking Exposed Network Security Secrets and Solutions, McGrowHill, 2012 ISBN: 978-0-07-178028-5 Digital Ref: http://84.209.254.175/linux-pdf/Hacking-Exposed-7-Network-Security-Secrets.pdfCollege libraries are requested to purchase the copy

Reference Books:

10. William Stallings, “Cryptography and Network Security: Principles and Practice”, 7/e, Pearson, ISBN:9789332585225. https://pearsoned.co.in/web/books/9789332585225_Cryptography-and-Network-Security_William-Stallings.aspx
11. Atul Kahate, “Cryptography and Network Security”, Mc Graw Hill Publication, 2nd Edition, 2008, ISBN : 978-0-07-064823-4

e-Books: https://www.simplilearn.com/introduction-to-cyber-security-beginners-guide-pdf

MOOC Courses: https://onlinecourses.swayam2.ac.in/cec20_cs15/preview

@The CO-PO mapping table

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

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

Hom

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

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

Unit I	Introduction to ANN	(07 Hours)

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-Mc Culloch & Pitts model, Perceptron, Adaline model,Basic learning laws, Applications of neural networks,Comparison of BNN and ANN.

#Exemplar/Case Studies	Controlling Water Reservoirs, Rule Extractions
Mapping of Course Outcomes for Unit I	CO1

Unit II	Learning Algorithms	07(Hours)

Learning and Memory, Learning Algorithms,Numbers of hidden nodes, Error Correction and Gradient Decent Rules, Perceptron Learning Algorithms, Supervised Learning Backpropagation, MultilayeredNetwork Architectures, Back propagation Learning Algorithm, Feed forward and feedback neural networks,example and applications.

#Exemplar/Case Studies	Medical diagnosis, Automated trading systems
Mapping of Course Outcomes for Unit II	CO2

Unit III	Associative Learning	07(Hours)

Introduction, Associative Learning, Hopfield network, Error Performance in Hopfield networks, simulated annealing, Boltzmann machine and Boltzmann learning, State transition diagram and false minima problem, stochastic update, simulated annealing.
Basic functional units of ANN for pattern recognition tasks: Pattern association, pattern classification and pattern mapping tasks.

#Exemplar/Case Studies	Understanding catastrophic, Interference in neural nets

Mapping of Course Outcomes for Unit III	CO3	
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		
#Exemplar/Case Studies	A Translation System for Face-to-Face Dialog and Intelligent Help Systems	
Mapping of Course Outcomes for Unit IV	CO4	
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		
#Exemplar/Case Studies	Large scale handwritten digit recognition problem	
Mapping of Course Outcomes for Unit V	CO5	
Unit VI	**Applications of ANN**	**06(Hours)**
Pattern classification – Recognition of Olympic games symbols, Recognition of printed Characters. Neocognitron – Recognition of handwritten characters. NET Talk: to convert English text to speech. Recognition of consonant vowel (CV) segments, texture classification and segmentation		
#Exemplar/Case Studies	Automating language translation	
Mapping of Course Outcomes for Unit VI	C06	

Learning Resources

Text Books:

1. Neural Networks a Comprehensive Foundations, Simon Haykin, PHI edition.
2. Laurene Fausett:Fundamentals of Neural Networks: Architectures, Algorithms & Apps, Pearson, 2004.
3. An introduction to neural networks, Gurney, Kevin, CRC press.

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 GRAW HILL EDUCATION, 2003
3. Neural Networks -James A Freeman David M S Kapura, Pearson Education, 2004.
4. Introduction to Artificial Neural Systems- Jacek M. Zurada, JAICO Publishing House Ed.,2006.

e-Books:

1.https://www.pdfdrive.com/neural-networks-a-comprehensive-foundationpdf-e18774300.html
2.https://www.pdfdrive.com/elements-of-artificial-neural-networks-e17103719.html
3.https://www.pdfdrive.com/neural-networks-methodology-and-applications-e38107895.html

MOOC Courses:

1.https://nptel.ac.in/courses/117105084
2. https://www.coursera.org/projects/predicting-weather-artificial-neural-networks

@The CO-PO mapping table

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

Home

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

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

Prerequisite Courses, if any: **Internet of Things (217529), Artificial Intelligence (310253)**

Companion Course, if any: **Mini Project (317536)**

Course Objectives:

- To impart knowledge aboutbasic mathematics related to industrial robots
- To Design and control application in robotics & automationIndustries

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 Automation, Types, Strategies, Automated Flow Lines, Automated Guided Vehicles, Automated Storage and Retrieval Systems, Introduction to CAD/ CAM/ CIM, Industry 4.0 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	Robot Specifications	
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	Case study on sensor selection	
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	CO2	
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	CO1	
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	CO3	
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 Robot Programming – Methods of Robot Programming, Lead through Programming, Motion Interpolation, Robot Language Structure, Programming in VAL II, motion commands, End effector and Sensor Commands, Monitor mode commands		
#Exemplar/Case Studies	Robot program on palletizing and Depalletizing	
Mapping of Course Outcomes for Unit VI	**CO4**	

Learning Resources

Text Books:

- Groover M.P.- Automation, production systems and computer integrated manufacturing‘ - Prentice Hall of India
- John Craig, Introduction to Robotics, Mechanics and Control, 3rd Edition, Pearson Education, 2009
- R K Mittal & I J Nagrath, Robotics and Control, McGraw Hill Publication, 2015
- 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												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	2	2	1	-	-	1	-	-	2
CO2	2	3	2	2	2	-	-	-	1	-	-	2
CO3	2	3	2	2	2	-	-	-	1	-	-	2
CO4	2	-	-	2	2	1	-	-	1	-	-	2

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Savitribai Phule Pune University
Third Year of Artificial Intelligence and Data Science (2019 Course)
Elective II
317532(B): Natural Language Processing

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

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 grammer, grammar rules for English, treebanks, grammar equivalence and normal forms, lexicalized grammer. **Constituency Parsing:** Ambiguity, CKY parsing, span based neural constituency parsing, evaluation parsers, partial parsing, CCG parsing, **Dependancy parsing:** dependancy relations, dependancy formalism, dependancy treebank, transition and graph based dependency parsing, evaluations.

#Exemplar/Case Studies	Dialogue systems and summarization
Mapping of Course Outcomes for Unit III	CO3

Unit IV	**Semantic Parsing**	**(8 Hours)**

Word Senses and WordNet: Word senses, relation between senses, WordNet, wordsense disambituition, 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.

#Exemplar/Case Studies	Semantic Parsing Using Content and Context
Mapping of Course Outcomes for Unit IV	CO4

Unit V	**Machine Translation (MT)**	**(8 Hours)**

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

#Exemplar/Case Studies	ANN, RNN
Mapping of Course Outcomes for Unit V	CO5

Unit VI	**Applications of NLP**	**(6 Hours)**

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

#Exemplar/Case Studies	Amazon Lex ,NLTK
Mapping of Course Outcomes for Unit VI	CO6

Learning Resources

Text Books:

1. Daniel Jurafsky, James H. Martin, “Speech and Language Processing”, Second Edition, Prentice Hall, 2008.
2. Christopher D.Manning and Hinrich Schutze,, “Foundations of Statistical Natural Language Processing” , MIT Press, 1999

Reference Books:

1. Steven Bird,Ewan Klein and Edword Loper,” NLP with Python:Analyzing text with the

Natural Language Toolkit", O'Reilly Media,Inc
2. Nitin Indurkhya and Fred J. Damerau, "Handbook of Natural Language Processing", 2nd ed. CRC press.

e-Books:

1. Yoav Goldberg. A primer on neural network models for natural language processing, 2015. URL http://u.cs.biu.ac.il/˜yogo/nnlp.pdf

MOOC Courses:

@The CO-PO mapping table

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

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Elective II
310254(C): Cloud Computing

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

Importance of Cloud Computing, Characteristics, Pros and Cons of Cloud Computing, Migrating into the Cloud, Seven-step model of migration into a Cloud, Trends in Computing. **Cloud Service Models**: SaaS, PaaS, IaaS, Storage. **Cloud Architecture**: Cloud Computing Logical Architecture, Developing Holistic Cloud Computing Reference Model, Cloud System Architecture, Cloud Deployment Models.

#Exemplar/Case Studies	Cloud Computing Model of IBM
***Mapping of Course Outcomes for Unit I**	CO1

Unit II	Data Storage and Cloud Computing	07 Hours

Data Storage: Introduction to Enterprise Data Storage, Direct Attached Storage, Storage Area Network, Network Attached Storage, Data Storage Management, File System, Cloud Data Stores, Using Grids for Data Storage. **Cloud Storage**: Data Management, Provisioning Cloud storage, Data Intensive Technologies for Cloud Computing. **Cloud Storage from LANs to WANs**: Cloud Characteristics, Distributed Data Storage.

#Exemplar/Case Studies	Online Book Marketing Service, Online Photo Editing Service
***Mapping of Course Outcomes for Unit II**	CO2

Unit III	Virtualization in Cloud Computing	07 Hours
Introduction: Definition of Virtualization, Adopting Virtualization, Types of Virtualization, Virtualization Architecture and Software, Virtual Clustering, Virtualization Application, Pitfalls of Virtualization. **Grid, Cloud and Virtualization**: Virtualization in Grid, Virtualization in Cloud, Virtualization and Cloud Security. **Virtualization and Cloud Computing**: Anatomy of Cloud Infrastructure, Virtual infrastructures, CPU Virtualization, Network and Storage Virtualization.		
#Exemplar/Case Studies	Xen: Para virtualization, VMware: Full Virtualization, Microsoft Hyper-V	
***Mapping of Course Outcomes for Unit III**	CO3	
Unit IV	**Cloud Platforms and Cloud Applications**	**07 Hours**
Amazon Web Services (AWS): Amazon Web Services and Components, Amazon Simple DB, Elastic Cloud Computing (EC2), Amazon Storage System, Amazon Database services (Dynamo DB).**Microsoft Cloud Services:** Azure core concepts, SQL Azure, Windows Azure Platform Appliance. **Cloud Computing Applications:** Healthcare: ECG Analysis in the Cloud, Biology: Protein Structure Prediction, Geosciences: Satellite Image Processing, Business and Consumer Applications: CRM and ERP, Social Networking, Google Cloud Application: Google App Engine. Overview of OpenStack architecture.		
#Exemplar/Case Studies	Multiplayer Online Gaming	
***Mapping of Course Outcomes for Unit IV**	CO4	
Unit V	**Security in Cloud Computing**	**07 Hours**
Risks in Cloud Computing: Risk Management, Enterprise-Wide Risk Management, Types of Risks in Cloud Computing. **Data Security in Cloud**: Security Issues, Challenges, advantages, Disadvantages, Cloud Digital persona and Data security, Content Level Security. **Cloud Security Services**: Confidentiality, Integrity and Availability, Security Authorization Challenges in the Cloud, Secure Cloud Software Requirements, Secure Cloud Software Testing.		
#Exemplar/Case Studies	Cloud Security Tool: Acunetix.	
***Mapping of Course Outcomes for Unit V**	CO5	
Unit VI	**Advanced Techniques in Cloud Computing**	**07 Hours**
Future Tends in cloud Computing, Mobile Cloud, **Automatic Cloud Computing**: Comet Cloud. **Multimedia Cloud**: IPTV, Energy Aware Cloud Computing, Jungle Computing, Distributed Cloud Computing Vs Edge Computing, Containers, Docker, and Kubernetes, Introduction to DevOps. **IOT and Cloud Convergence**: The Cloud and IoT in your Home, The IOT and cloud in your Automobile, PERSONAL: IoT in Healthcare.		
#Exemplar/Case Studies	**Case studies on Dev Ops: DocuSign, Forter, Gengo.**	
***Mapping of Course Outcomes for Unit VI**	CO6	
Learning Resources		

Text Books :

1. A. Srinivasan, J. Suresh, "Cloud Computing: A Practical Approach for Learning and Implementation", Pearson, ISBN: 978-81-317-7651-3
2. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, "Mastering Cloud Computing", McGraw Hill Education, ISBN-13:978-1-25-902995-0

Reference Books :

1. James Bond ,"The Enterprise Cloud", O'Reilly Media, Inc. ISBN: 9781491907627
2. Dr. Kris Jamsa, "Cloud Computing: SaaS, PaaS, IaaS, Virtualization and more", Wiley Publications, ISBN: 978-0-470-97389-9
3. Anthony T. Velte Toby J. Velte, Robert Elsenpeter, "Cloud Computing: A Practical Approach", 2010, The McGraw-Hill.
4. Gautam Shrof, "ENTERPRISE CLOUD COMPUTING Technology Architecture, Applications", Cambridge University Press, ISBN: 9780511778476
5. Tim Mather, Subra K, Shahid L.,"Cloud Security and Privacy", Oreilly, ISBN-13 978-81-8404-815-5
6. Dr. Kumar Saurabh, "Cloud Computing, 4ed: Architecting Next-Gen Transformation Paradigms", Wiley publication, ISBN: 9788126570966
7. Rishabh Sharma, "Cloud Computing: Fundamentals, Industry Approach and Trends", Wiley publication, ISBN:

e-Books :

- https://sjceodisha.in/wp-content/uploads/2019/09/CLOUD-COMPUTING-Principles-and-Paradigms.pdf
- https://studytm.files.wordpress.com/2014/03/hand-book-of-cloud-computing.pdf
- https://arpitapatel.files.wordpress.com/2014/10/cloud-computing-bible1.pdf
- https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.500-291r2.pdf

MOOCs Courses link:

- Cloud Computinghttps://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

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

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Elective II

310254(D): Software Modeling and Architecture

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

Unit I	Concepts of Software Modeling	07 Hours

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

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

Unit II	Static Modeling	07 Hours

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

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

#Exemplar/Case Studies	UML Static Diagrams for Real life applications (e.g., Online shopping system).	
***Mapping of Course Outcomes for Unit II**	CO1 ,CO2	
Unit III	**Dynamic Modeling**	**07 Hours**
Activity diagram: Different Types of nodes, Control flow, Activity Partition, Exception handler, Interruptible activity region, Input and output parameters, Pins. **Interaction diagram**: Sequence diagram, Interaction Overview diagram, State machine diagram, Advanced State Machine diagram, Communication diagram, Timing diagram.		
#Exemplar/Case Studies	UML dynamic Diagrams of for Real life applications.	
***Mapping of Course Outcomes for Unit III**	CO1 ,CO2	
Unit IV	**Software Architecture and Quality Attributes**	**07 Hours**
Introduction to Software Architecture, Importance of Software Architecture, Architectural Structure and Views. **Architectural Pattern**: common module, Common component-and-connector, Common allocation. **Quality Attributes**: Architecture and Requirements, Quality Attributes and Considerations		
#Exemplar/Case Studies	Case study of any real-life application	
***Mapping of Course Outcomes for Unit IV**	CO3	
Unit V	**Architectural Design and Documentation**	**07 Hours**
Architecture in the Life Cycle: Architecture in Agile Projects, Architecture and Requirements, Designing an Architecture. **Documenting Software Architecture**: Notations, Choosing and Combining views, Building the documentation Package, Documenting Behavior, Documenting Architecture in an Agile Development Project.		
#Exemplar/Case Studies	Air Traffic Control.	
***Mapping of Course Outcomes for Unit V**	CO4 , CO5	
Unit VI	**Design Patterns**	**07 Hours**
Design Patterns: Introduction, Different approaches to select Design Patterns. **Creational patterns**: Singleton, Factory, Structural pattern: Adapter, Proxy. **Behavioral Patterns**: Iterator, Observer Pattern with applications.		
#Exemplar/Case Studies	Flight Simulation	
***Mapping of Course Outcomes for Unit VI**	CO4, CO5	

Learning Resources

Text Books :

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

3. Erich Gamma, "Design Patterns", Pearson, ISBN 0-201-63361-2.

Reference Books :

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

e-Books :

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

MOOCs Courses link

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

@ The CO-PO Mapping Matrix

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

Savitribai Phule Pune University
Third Year of Artificial Intelligence and Data Science (2019 Course)
317533: Software Laboratory II

Teaching Scheme:	Credit	Examination Scheme:
PR: 04 Hours/Week	02	Term Work (TW): 25 Marks Practical(PR): 25 Marks

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
CO4: Design and develop applications using neural networks.

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 **handwritten 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 besubmitted 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
7. Implement Artificial Neural Network training process in Python by using Forward Propagation, Back Propagation.
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:

1. Neural Networks a Comprehensive Foundations, Simon Haykin, PHI edition.
2. Laurene Fausett:Fundamentals of Neural Networks: Architectures, Algorithms & Apps, Pearson, 2004.
3. Learn TensorFlow 2.0: Implement Machine Learning and Deep Learning Models with Python 1st ed. Edition, Apress publication

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:

1. https://www.inf.ed.ac.uk/teaching/courses/nlu/assets/reading/Gurney_et_al.pdf
2. http://neuralnetworksanddeeplearning.com/

MOOC Courses:

1. **http://neuralnetworksanddeeplearning.com/**
2. **https://www.coursera.org/learn/convolutional-neural-networks-tensorflow**
3. **https://nptel.ac.in/courses/106106213**

@The CO-PO mapping table

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

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

Teaching Scheme:	Credit	Examination Scheme:
PR: 04 Hours/Week	02	Term Work (TW): 50 Marks Practical(PR): 25 Marks

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

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

Guidelines for Student's Laboratory Journal

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

Guidelines for Laboratory /Term Work Assessment

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

Guidelines for Practical Examination

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

promising start of student's academics

Guidelines for Laboratory Conduction

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

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"
- http://cse20-iiith.vlabs.ac.in/List%20of%20Experiments.html?domain=Computer%20Science

List of Assignments

Group A : Data Science

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 DocumentFrequency.

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.

Group B- Data Analytics – JAVA/SCALA(Any Two)

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
3. Develop a movie recommendation model using the scikit-learn library in python. Refer dataset https://github.com/rashida048/Some-NLP-Projects/blob/master/movie_dataset.csv
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 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 d. 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:

1. Chirag Shah, “A Hands-On Introduction To Data Science”, Cambridge University Press,(2020), ISBN : ISBN 978-1-108-47244-9.
2. Python for Data Analysis by Wes McKinney published by O' Reilly media, ISBN : 978-1-449-31979-3.
3. Scikit-learn Cookbook , Trent hauk,Packt Publishing, ISBN: 9781787286382
4. R Kent Dybvig, ―the Scheme Programming Language‖, MIT Press, ISBN 978-0-262-51298-5.
5. Data Analytics with Hadoop, Jenny Kim, Benjamin Bengfort, OReilly Media, Inc.
6. Python Data Science Handbook by Jake VanderPlas https://tanthiamhuat.files.wordpress.com/2018/04/pythondatasciencehandbook.pdf
7. An Introduction to Statistical Learning by Gareth James https://www.ime.unicamp.br/~dias/Intoduction%20to%20Statistical%20Learning.pdf
8. Cay S Horstmann, ―Scala for the Impatient‖, Pearson, ISBN: 978-81-317-9605-4,
9. Scala Cookbook, Alvin Alexander, O‘Reilly, SPD,ISBN: 978-93-5110-263-2

References :

- https://www.simplilearn.com/data-science-vs-big-data-vs-data-analytics-article
- https://hadoop.apache.org/docs/current/hadoop-mapreduce-client/hadoop-mapreduce-client-core/MapReduceTutorial.html
- https://www.edureka.co/blog/hadoop-ecosystem
- https://www.edureka.co/blog/mapreduce-tutorial/#mapreduce_word_count_example

- https://github.com/vasanth-mahendran/weather-data-hadoop
- 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/

@The CO-PO mapping table

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

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

Teaching Scheme:	Credit	Examination Scheme:
**	04	Term Work (TW): 50 Marks Oral(OR): 50 Marks

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.

Reference:
[1] https://www.aicte-india.org/sites/default/files/AICTE%20Internship%20Policy.pdf
[2] https://internship.aicte-india.org/

@The CO-PO Mapping table

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

Home

Savitribai Phule Pune University
Third Year of Artificial Intelligence and Data Science (2019 Course)
317536: Mini Project

Teaching Scheme:	Credit	Examination Scheme:
TH: 02 Hours/Week	01	Term Work (TW): 50 Marks Oral(OR): 25 Marks

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 filternetwork trafficand 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 theproducts 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:

1. Nina Godbole, SunitBelapure, "Cyber Security- Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wilely India Pvt.Ltd.,ISBN- 978-81-265-2179-1.
2. William Stallings, "Computer Security : Principles and Practices", Pearson 6thEd. ISBN :978-81-317-3351-6

Reference Books:

1. BerouzForouzan, "Cryptography and Network Security", 2nd Ed. TMH, ISBN: 9780070702080.
2. Mark Merkow, "Information Security-Principles and Practices", Pearson Ed. 978-81-317-1288-7.
3. CK Shyamala, "Cryptography and Security", Wiley India Pvt. Ltd, ISBN 978-81-265-2285-9

e-Books: https://heimdalsecurity.com/pdf/cyber_security_for_beginners_ebook.pdf

MOOC Courses:

@The CO-PO mapping table

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

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

form Assignment 6 to Assignment 9

Learning Resources

Text Books:

1. Groover M.P.- Automation, production systems and computer integrated manufacturing' - Prentice Hall of India
2. John Craig, Introduction to Robotics, Mechanics and Control, 3rd Edition, Pearson Education, 2009
3. R K Mittal & I J Nagrath, Robotics and Control, McGraw Hill Publication, 2015
4. Ganesh Hegde, Industrial Robotics, Laxmi publication
5. S. K. Saha, Introduction to Robotics, TMH International
6. Groover, Industrial Robotics, Tata McGraw-Hill Education

Reference Books:

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

@The CO-PO mapping table

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

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 Chabot. (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:

1. Steven Bird,Ewan Klein and EdwordLoper," NLP with Python:Analyzing text with the Natural Language Toolkit", O'Reilly Media,Inc

Reference Books:

1. Steven Bird,Ewan Klein and EdwordLoper," NLP with Python:Analyzing text with the Natural Language Toolkit", O'Reilly Media,Inc.
2. Nitin Indurkhya and Fred J. Dameau, "Handbook of Natural Language Processing", 2nd ed. CRC press.

e-Books:

1. Yoav Goldberg. A primer on neural network models for natural language processing, 2015. URL http://u.cs.biu.ac.il/˜yogo/nnlp.pdf

MOOC Courses:

@The CO-PO mapping table

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2									
CO2	2	3	3									
CO3	2	3	3							2	2	

Part B : Elective II : Cloud Computing

PrerequisiteCourses,ifany:Database Management System (310241)

CompanionCourse,ifany:

CourseObjectives:

- To Learn AWS environment.
- To Learn Amazon RDS.
- Todesignand developdifferentapplicationsusing Amazon Sevices.

CourseOutcomes:

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 SoftwareModelingandArchitecture
- ToUsetoolsandtechniquesofSoftwareModelingandArchitecture
- To DesignanddevelopapplicationsusingUML
- To ApplytheknowledgeofSoftwareModelingandArchitectureforproblemsolving

Course Outcomes:

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

CO1: UsetoolsandtechniquesofSoftwareModelingandArchitecture

CO2: ApplytheknowledgeofSoftwareModelingandArchitectureforproblemsolving

CO3: DesignanddevelopapplicationsusingUML

List of Assignments

Select a moderately complex system which has at least 4-5 major functionalities. Identify stakeholders. Actors and write detail 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 UML2.O(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:

1.JimArlow,IlaNeustadt,“UML2andtheunifiedprocess–practicalobject-orientedanalysis anddesign”,AddisonWesley,Secondedition,ISBN978-0201770605

2.LenBass,PaulClements,RickKazman,"SoftwareArchitectureinPractice",Second Edition,Pearson,ISBN978-81-775-8996-2

3. Hassan Gomaa, “SoftwareModelingandDesign- UML,Use cases,PatternsandSoftware Architectures”,CambridgeUniversityPress,2011,ISBN978-0-521-76414-8

Erich Gamma,“DesignPatterns”, Pearson, ISBN 0-201-63361-2

References Books:

1.GardyBooch,JamesRambaugh,IvarJacobson,“Theunifiedmodelinglanguageuserguide”,

PearsonEducation,Secondedition,2008,ISBN0-321-24562-8.
2.LanSommerville,"SoftwareEngineering",9thedition,ISBN-13:978-0-13-703515-1ISBN-10:0-13-703515-2.

e-Books:

1. https://dhomaseghanshyam.files.wordpress.com/2016/02/gomaa-softwaremodellinganddesign.pdf

MOOC Courses:

@The CO-PO mapping table

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

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SavitribaiPhule Pune University
Third Year of Artificial Intelligence and Data Science (2019 Course)
317537(A): Audit Course6
AC6-A: Digital and Social Marketing

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:

3. Avery Swartz, “See You on the Internet: building your small business with Digital Marketing”, ISBN 978-1-989603-08-6
4. Damiyan Ryan, “Understanding Digital Marketing: Marketing strategies for engaging the digital generation”, ISBN: 978 0 7494 6968 9

e-Books: --

MOOC Courses: --

@The CO-PO mapping table

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

SavitribaiPhule Pune University
Third Year of Artificial Intelligence and Data Science (2019 Course)
317537(B): Audit Course6
AC6-B: Sustainable Energy Systems

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
3. **Solar thermal energy conversion systems:** Solarradiation and its measurement, Solar water heating, Solar thermal power plants, Solar ponds, Solar pumping systems, Solar air heaters, Solar crop drying, Solar cookers, Energy efficient buildings, Solar greenhouses
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:

1.D.P.Kothari, K.C Singal, RakeshRanjan,"Renewable Energy Sources and EmergingTechnologies", PHI Learning Pvt.Ltd, New Delhi, 2013.
2. Joshua Earnest, Tore Wizeliu, "Wind Power Plants and Project Development", PHI LearningPvt.Ltd, New Delhi, 2011.
3. A.K.Mukerjee and Nivedita Thakur, "Photovoltaic Systems: Analysis and Design", PHI Learning Private Limited, New Delhi, 2011

@The CO-PO mapping table

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

SavitribaiPhule Pune University
Third Year of Artificial Intelligence and Data Science (2019 Course)
317537(C): Audit Course6
AC6-C: Leadership and Personality Development

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 individualas 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 team work,interpersonal skills and leadership qualities

Course Contents

1. PersonalityDevelopment: A Must for Leadership and CareerGrowth

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:

1. Barun K Mitra, (2011), "Personality Development and Soft skills", First Edition, Oxford Publishers, ISBN: 780199459742, ISBN: 0199459746
2. UrmilaRai and S.M. Rai, "Business Communication", Himalay Publication House
3. Shiv Khera, "You Can Win", A&C Black, ISBN: 9780230331198
4. Dale Carnegie, "How to win Friends and Influence People", New York: Simon & Schuster,

1998, ISBN: 1-4391-6734-6
5. Paul Sloane, "The Leader's Guide to Lateral Thinking Skills Unlocking the Creativity and Innovation in You and Your Team", 2006
6. Ronald Bennett, Elaine Millam,"Leadership for engineers : the magic of mindset"
7. Baron R, Byrne D, Branscombe N, BharadwajG (2009), "Social Psychology, Indian adaptation" , Pearson , New Delhi
8. Baumgartner S.R, Crothers M.K. (2009) "Positive Psychology", Pearson Education

@The CO-PO mapping table

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

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SavitribaiPhule Pune University
Third Year of Artificial Intelligence and Data Science (2019 Course)
317537(D): Audit Course6
AC6-D: Foreign Language(Japanese)-Module 3

Prerequisite Courses: We recommend that candidates should have previously completed **AC3-V(217527-V), AC4-V (217535-V) andAC5-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;
3. Lessons: Karate, Park(Playground), The Grandpa's Inaka, The Sun and the Moon, My littlesister, Rice Fields, My Teacher, People who Exit and People who Enter.

Learning Resources

Reference Books:

1. Banno, Eri, Yoko Ikeda, et al. Genki I, “An Integrated Course in Elementary Japanese”, 2nded. Japan Times/Tsai Fong Books, 2011. ISBN: 9784789014403
2. Anna Sato and Eriko Sato, “My First Japanese Kanji Book, Learning kanji the fun and easyway”, TUTTLE PUBLISHING, First Edition ISBN: 978-1-4629-1369-5 (eBook)

e-Books:

- Japanese Kanji and Kana,“A complete guide to the Japanese writing system”, Wolfgang Hadamitzky& Mark Spahn, Tuttle Publishing, Third edition ISBN: 978-1-4629-1018-2

MOOC Courses:

@The CO-PO mapping table

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

SavitribaiPhule Pune University
Third Year of Artificial Intelligence and Data Science (2019 Course)
317537(E): Audit Course6
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:

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

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												

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 situation, 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. PrashantM. 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. Venkatesharan, Dr. Geetanjali Kale, Dr. Suhasini Itkar, Dr. R. V. Patil, Dr. P. M. Yawalkar and Dr. Swati Bhavsar.

Task Force at Curriculum Design

Home

1. Advisors, the Team of Board of Studies-

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3. Teams, Course Design-

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Elective I: Human Computer Interface	Dr. S. D. Babar	Prof. Mrs. G. J. Chhajed Prof. D.D.Sapkal Prof. Mrs.Jayshree R. Pansare Mr. Mukesh Jain (Industry) Prof. Mrs. Shailaja N. Lohar	Prof. S. A. Thanekar Dr.Deepak Dharrao Dr. Ganesh Bhutkar Mr. Himmat Sankhala (Industry)
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Elective I: Design Thinking	Dr. K. S. Wagh	Dr. Limkar S. V. Sanjay Agrawal	Dr. S. K. Pathan Dr. Amol Dhumne
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CN Laboratory	Dr. Amol Potgantwar	V. D. Dabhade Radhika Adki	Tushar Kute (Industry)
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Elective II: Natural Language Processing	Dr. P. N. Kalavadekar	Dr. Mubin Tamboli Dr. Suvarna Bhagwat	Mr. Arpit Yadav (Industry)
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Software Laboratory III	Sneha Salvekar	Dr. D. V. Patil D. J. Bonde	Dr. Mahesh Sanghvi
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