Faculty of Science & Technology
Savitribai Phule Pune University, Pune
Maharashtra, India

Curriculum for
Third Year of Artificial Intelligence and Machine Learning (2020 Course)
(With effect from AY 2022-23)

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I N D E X

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Savitribai Phule Pune University, Pune	
Bachelor of Artificial Intelligence(AI) & Machine Learning(ML)	
Program Educational Objectives	
PEO1	Possess strong fundamental concepts in mathematics, science, engineering and Technology to address technological challenges.
PEO2	Possess knowledge and skills in the field of AI & ML for analyzing, designing and implementing complex engineering problems of any domain with innovative approaches.
PEO3	Possess an attitude and aptitude for research, entrepreneurship and higher studies in the field of Artificial Intelligence & Machine Learning
PEO4	Have commitment to ethical practices, societal contributions through communities and life-long learning.
PEO5	Possess better communication, presentation, time management and teamwork skills leading to responsible & competent professionals and will be able to address challenges in the field of AI & ML at global level.

Program Outcomes		
Students are expected to know and be able to–		
PO1	Engineering knowledge	An ability to apply knowledge of mathematics, computing, science, engineering and technology.
PO2	Problem analysis	An ability to define a problem and provide a systematic solution with the help of conducting experiments, analyzing the problem and interpreting the data.
PO3	Design / Development of Solutions	An ability to design, implement, and evaluate a software or a software/hardware system, component, or process to meet desired needs within realistic constraints.
PO4	Conduct Investigations of Complex Problems	An ability to identify, formulates, and provides systematic solutions to complex engineering/Technology problems.
PO5	Modern Tool Usage	An ability to use the techniques, skills, and modern engineering technology tools, standard processes necessary for practice as a IT professional.
PO6	The Engineer and Society	An ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems with necessary constraints and assumptions.
PO7	Environment and Sustainability	An ability to analyze and provide solution for the local and global impact of information technology on individuals, organizations and society.
PO8	Ethics	An ability to understand professional, ethical, legal, security and social issues and responsibilities.
PO9	Individual and Team Work	An ability to function effectively as an individual or as a team member to accomplish a desired goal(s).
PO10	Communication Skills	An ability to engage in life-long learning and continuing professional development to cope up with fast changes in the technologies/tools with the help of electives, professional organizations and extra-curricular activities.
PO11	Project Management and Finance	An ability to communicate effectively in engineering community at large by means of effective presentations, report writing, paper publications, demonstrations.
PO12	Life-long Learning	An ability to understand engineering, management, financial aspects, performance, optimizations and time complexity necessary for professional practice.

Program Specific Outcomes (PSO)	
A graduate of the Artificial Intelligence & Machine Learning Program will demonstrate-	
PSO1	An ability to apply the theoretical concepts and practical knowledge of Artificial Intelligence & Machine Learning in analysis, design, development and management of information processing systems and applications in the interdisciplinary domain.
PSO2	An ability to analyze a problem, and identify and define the computing infrastructure and operations requirements appropriate to its solution. AI & ML graduates should be able to work on large-scale computing systems.
PSO3	An understanding of professional, business and business processes, ethical, legal, security and social issues and responsibilities.
PSO4	Practice communication and decision-making skills through the use of appropriate technology and be ready for professional responsibilities.

Home

Course Code	Course Name	Teaching Scheme (Hours/Week)			Examination Scheme and Marks						Credit			
		Theory	Practical	Tutorial	IN-Sem	End-Sem	TW	PR	OR	Total	TH	PR	TUT	Total
318541	Design and analysis of Algorithm	03	-	-	30	70	-	-	-	100	03	--	-	03
318542	IoT with Artificial Intelligence	03	-	-	30	70	-	-	-	100	03	--	-	03
318543	Web Technology	03	-	-	30	70	-	-	-	100	03	-	-	03
318544	Management & Entrepreneurship for IT Industry	03	-	-	30	70	-	-	-	100	03	-	-	03
318545	Elective I	03	-	-	30	70	-	-	-	100	03	-	-	03
318546	Software Laboratory I (IoT with Artificial Intelligence)	-	04	-	-	-	25	25	-	50	-	02	-	02
318547	WT Laboratory	-	02	-	-	-	25	25	-	50	-	01	-	01
318548	Elective - I Laboratory	-	02	-	-	-	25	-	25	50	-	01	-	01
318549	Seminar / Mini Project	-	-	01	-	-	25	-	-	25	-	-	01	01
318550	Environmental Studies / Community Development	-	-	01	-	-	25	-	-	25	-	-	01	01
318551	Mandatory Audit Course 3*	-	-	-	-	-	-	-	-	-	Non Credit			-
Total		15	8	02	150	350	125	50	25	700	15	04	02	21

Savitribai Phule Pune University, Pune
TE (Artificial Intelligence & Machine Learning Engineering) 2020 Course
(With effect from Academic Year 2022-23)
Semester-V

Abbreviations:
TH: Theory   TW: Term Work   PR: Practical
OR: Oral   TUT: Tutorial
Note: Students of T.E. (Artificial Intelligence & Machine Learning) can opt any one of the audit courses from the list of audit courses prescribed by BoS (Information Technology Engineering)
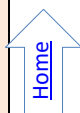
ElectiveI:	*Mandatory Audit Course 3:
318545(A) Robotics	**318551(**A)- Road Safety
318545(B) Pattern Recognition	**318551(**B)- Engineering Economics
318545(C) Information Security	**318551(**C) - Language Study-Module III
318545(D) Business Intelligence	**318551(**D) - MOOC- Learn New skills

	SavitribaiPhule Pune University, Pune TE (Artificial Intelligence & Machine Learning Engineering) 2020 Course (With effect from Academic Year 2022-23)														
	Semester-VI														
Course Code	Course Name	Teaching Scheme (Hours/Week)			Examination Scheme and Marks						Credit			
		Theory	Practical	Tutorial	IN-Sem	End-Sem	TW	PR	OR	Total	TH	PR	TUT	Total
318552	Machine intelligence for Data Science	03	-	-	30	70	-	-	-	100	03			03
318553	Data Mining & Warehousing	03	-	-	30	70	-	-	-	100	03			03
318554	Artificial Neural Network	03	-	-	30	70	-	-	-	100	03			03
318555	Elective II	03	-	-	30	70	-	-	-	100	03			03
318556	Software Lab II (machine intelligence for data science& ANN)	-	04	-	-	-	50	25	-	75		02		01
318557	Software Lab III (DMW & Elective – II)	-	04	-	-	-	50	25		75		02		01
318558	Internship / Skill Development / Global Certification Program	-	08	-	-	-	50	-	50	100		04		06
318559	Seminar & Technical Communication			01			25		25	50			01	01
318560	Mandatory Audit Course 4#	-	-	-	-	-	-	-	-	-	Non Credit			-
	Total	12	16	01	120	280	175	50	75	700	12	08	01	21

Abbreviations:

TH: Theory   TW: Term Work   PR: Practical

OR: Oral   TUT: Tutorial

Note: Students of T.E. (Artificial Intelligence & Machine Learning) can opt any one of the audit Courses from

the list of audit courses prescribed by BoS(Information Technology Engineering)

ElectiveII: **318555(A)**Industrial Internet of Things **318555(B)**Brain computer interface **318555(C)**AI for cyber security **318555(D)**Video Analytics	**#Mandatory Audit Course 4:** **318560(**A)The Science of Happiness **318560(**B)Emotional Intelligence **318560(**C)Language Study- Module IV **318560(**D)MOOC-New skills

INSTRUCTIONS

❖ Practical or Tutorial must be conducted in batches and number of batches per division should be as per guidelines from regulatory bodies.

❖ Required minimum number of experiments/ assignments in practical/ tutorial shall be conducted as mentioned in the syllabi of respective subjects. The list of experiments/assignments is prescribed in the syllabi.

❖ In addition to the prescribed list, the instructor for practical/ tutorial may design one or two additional experiments/assignments relating to the subject covering some of the research/application areas of the concerned subject.

❖ For practical/tutorial subject, each experiment/assignment, the student must prepare a write-up consisting of assignment statement, objective(s)/outcome(s), algorithm(s), flow charts/UML diagram(s), important test cases, test case validation report etc.

❖ The faculty member/instructor should prepare a rubric for the assessment of practical and tutorial. Assessment of tutorial work is part of term-work examination. Term-work Examination at second year of engineering course shall be internal continuous assessment only.

❖ Project based learning (PBL) requires mentoring and internal continuous assessment by faculty throughout the semester for successful completion of the tasks assigned to the students. A teaching workload of 4 hours/week/batch is associated with PBL subject should be allocated to the faculty conducting PBL mentoring and internal continuous assessment. The students in a Batch may be divided into sub-groups of 5 to 6 students for easing the process of internal continuous assessment. Assignments/activities/models/ projects etc. completed under project-based learning will be considered for internal continuous assessment, evaluation, and award of credits for PBL subjects.

❖ Audit course is a mandatory non-credit course. The faculty member should prepare the rubric(s) for the assessment of audit course at the start of semester. The assessment should be carried out based on the said rubric(s) only and report should be prepared and submitted to the department at the end of semester.

❖ Case Studies may be assigned as a self-study to students and to be excluded from theory examinations.

❖ All the rules, regulations and guidelines issued by regulatory authorities from time to time for effective conduction of curriculum, assessment and evaluation are to be strictly followed

SEMESTER – V

Savitribai Phule Pune University, Pune
Third Year of Artificial Intelligence and Machine Learning (2020 Course)
318541: Design and Analysis of Algorithm

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory (TH) : 3 hrs/week	03 Credits	Mid_Semester : 30 Marks End_Semester : 70 Marks

Prerequisite Courses:
- Data Structures and Algorithms.
- Discrete Structures.
- Basic Mathematics: Induction, Probability theory, Logarithms.

Course Objectives:
- To know the basics of computational complexity analysis and various algorithm design paradigms.
- To study algorithmic design strategies
- To provide students with solid foundations to deal with a wide variety of computational problems.
- To provide a thorough knowledge of the most common algorithms.
- To analyze a problem and identify the computing requirements appropriate for its solutions
- To understand the concept of nondeterministic polynomial algorithms.

Course Outcomes:

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

CO1: Calculate computational complexity using asymptotic notations for various algorithms**.**

CO2: Demonstrate a familiarity with divide-conquer and greedy algorithms.

CO3: Describe and analyze the dynamic-programming paradigm for optimal solution.

CO4: Solve problems using backtracking approach.

CO5: Compare different methods of Branch and Bound strategy.

CO6: Classify P, NP, and NP Complete, NP hard problem.

COURSE CONTENTS

Unit I	INTRODUCTION	(07 hrs)

Proof Techniques: Contradiction, Mathematical Induction, Direct proofs, Proof by counter example, Proof by contraposition.

Analysis of Algorithm: Efficiency- Analysis framework, Asymptotic notations – Big O,Theta and Omega.
Analysis of Non-recursive and recursive algorithms: Solving Recurrence Equations using Masters theorem and Substitution method.

Brute Force method: Introduction to Brute Force method & Exhaustive search, Brute Force solution to 8 Queens' problem

Mapping of Course Outcomes for Unit I	CO1	
Unit II	**DIVIDE & CONQUER AND GREEDY METHOD**	**(06 hrs)**

Divide & Conquer: General method, Control abstraction, Merge sort, Quick Sort – Worst, Best and average case. Binary search, Large integer Multiplication, Strassen's Matrix multiplication (for all above algorithms analysis to be done with recurrence).

Greedy Method: General method and characteristics, Prim's method for MST , Kruskal method for MST (using n logn complexity), Dijkstra's Algorithm, Huffman Trees (n logn complexity), Fraction Knapsack problem, Job Sequencing.

Mapping of Course Outcomes for Unit II	CO2	
Unit III	**DYNAMIC PROGRAMMING**	**(06 hrs)**

General strategy, Principle of optimality, Warshal's and Floyd's Algorithm, Optimal Binary Search Trees, 0/1 knapsack Problem, Travelling Salesman Problem.

Mapping of Course Outcomes for Unit III	CO3	
Unit IV	**BACKTRACKING**	**(06 hrs)**

General method, Recursive backtracking algorithm, iterative backtracking method. 8- Queens problem, Sum of subsets, Graph coloring, Hamiltonian Cycle, 0/1 Knapsack Problem.

Mapping of Course Outcomes for Unit IV	CO4	
Unit V	**BRANCH AND BOUND**	**(06 hrs)**

The method, Control abstractions for Least Cost Search, Bounding, FIFO branch and bound, LC branch and bound, 0/1 Knapsack problem – LC branch and bound and FIFO branch and bound solution, Traveling sales person problem.

Mapping of Course Outcomes for Unit V	CO5	
Unit VI	**COMPUTATIONAL COMPLEXITY AND PARALLEL ALGORITHMS**	**(05 hrs)**

Non Deterministic algorithms, The classes P, NP, NP Complete, NP hard.

Proofs for NP Complete Problems: Clique, Vertex Cover

Parallel Algorithms: Introduction, models for parallel computing, computing with complete binary tree, Pointer doubling algorithm

Mapping of Course Outcomes for Unit VI	CO6	

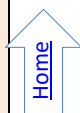| Text Books: |
|---|
| 1. Horowitz and Sahani, "Fundamentals of computer Algorithms", Galgotia. ISBN 81-7371-612-9 |
| 2. R.C.T.Lee, S S Tseng, R C Chang, Y T Tsai " Introduction to Design and Analysis of Algorithms, A Strategic approach" Tata McGraw Hill. ISBN-13:978-1-25-902582-2. ISBN-10:1-25-902582-9 |
| 3. Gilles Brassard, Paul Bratle "Fundamentals of Algorithms ", Pearson ISBN 978-81-317-1244-3 |
| Reference Books: |
| 1. Jon Kleinberg, Algorithm Design, Pearson, ISBN : 0-321-29535-8 |
| 2. S. Sridhar, Design and Analysis of Algorithms, Oxford, ISBN 10: 0-19-809369-1. |
| 3. Thomas H Cormen and Charles E.L Leiserson, Introduction to Algorithm, PHI, ISBN: 9788120340077 |
| 4. Gilles Brassard, Paul Bratle, Fundamentals of Algorithms, Pearson, ISBN 978-81-317-1244-3. |
| 5. R. C. T. Lee, SS Tseng, R C Chang, Y T Tsai, Introduction to Design and Analysis of Algorithms, A Strategic approach, Tata McGraw Hill, ISBN-13: 978-1-25-902582-2. ISBN-10: 1-25-902582-9. |
| 6. Steven S Skiena, The Algorithm Design Manual, Springer, ISBN 978-81-8489-865-1. |
| 7. George T. Heineman, Gary Pollice, Stanley Selkow, Algorithms in a Nutshell, A Desktop Quick Reference, O'Reilly, ISBN: 9789352133611. |
| 8. Michael T. Goodrich, Roberto Tamassia, Algorithm Design: Foundations, Analysis and Internet |
| 9. Examples, Wiley India, ISBN: 9788126509867 |
| 10. Rod Stephens, Essential Algorithms: A Practical Approach to Computer Algorithms, Wiley India, ISBN: 9788126546138 |

Savitribai Phule Pune University, Pune **Third Year of Artificial Intelligence and Machine Learning (2020 Course)** **318542: IoT with Artificial Intelligence**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory (TH) : 3 hrs/week	**03 Credits**	**Mid_Semester : 30 Marks** **End_Semester :70 Marks**

Prerequisite Courses, if any: Computer Networks, Computer Programming

Companion Course, if any: (318546) IoT with Artificial Intelligence Laboratory

Course Objectives:

At the end of the course, the students will be able to-
- To understand Smart Objects and IoT Architectures.
- Design application using IoT.
- To learn about various IOT-related protocols.
- To build IoT Systems using Arduino and Raspberry Pi.
- To understand data analytics and cloud in the context of IoT
- Determine the real world problems and challenges in IoT .

Course Outcomes:

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

CO1: Understand internet of Things and its hardware and software components.

CO2: Describe intelligent IOT systems.

CO3: Analyze Protocol standardization for IOT.

CO4: Perform an analysis of IOT security issues using AI technology.

CO5: Identify the role of cloud computing in IOT.

CO6: Develop IoT infrastructure for popular applications.

COURSE CONTENTS		
Unit I	**INTRODUCTION TO INTERNET OF THINGS**	**(06 hrs)**

Introduction to Internet of Things – Definition & Characteristics, Importance of IoT, Physical Design of IOT, Logical Design of IOT, IOT Enabling technologies, IOT Levels & Deployment Templates, IoT and M2M, The role of Artificial Intelligence in IOT, Introduction to AIOT, Applications of Artificial Intelligence in Internet of Things: Collaborative Robots, Digital Twins, Drones, Smart Retailing, Smart Cities, Smart Health, etc.

Mapping of Course Outcomes for Unit I	CO1

Unit II	Fundamentals of IoT	(07 hrs)
Evolution of Internet of Things, Enabling Technologies, IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT models, Simplified IoT Architecture and Core IoT Functional Stack, Fog, Edge and Cloud in IoT, Functional blocks of an IoT ecosystem, Sensors, Actuators, Smart Objects and Connecting Smart Objects.		
Mapping of Course Outcomes for Unit II	CO2	
Unit III	IoT PROTOCOLS	(07 hrs)
IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.11ah and Lora WAN, Network Layer: IP versions, Constrained Nodes and Constrained Networks,6LoWPAN, Application Transport Methods: SCADA, Application Layer Protocols: CoAP and MQTT.		
Mapping of Course Outcomes for Unit III	CO3	
Unit IV	IoT Application Development	(07 hrs)
Solution framework for IoT applications- Implementation of Device integration, Data acquisition and integration, Device data storage- Unstructured data storage on cloud/local server, Authentication, authorization of devices.		
Mapping of Course Outcomes for Unit IV	CO4	
Unit V	Data Analytics And Supporting Services	(06 hrs)
Data Analytics: Introduction, Structured Versus Unstructured Data, Data in Motion versus Data at Rest, IoT Data Analytics Challenges, Data Acquiring, Organizing in IoT/M2M. **Supporting Services:** Computing Using a Cloud Platform for IoT/M2M Applications/Services, Everything as a service and Cloud Service Models.		
Mapping of Course Outcomes for Unit V	CO5	
Unit VI	AI and the Internet of Thing: Real World	(06 hrs)
Real world design constraints - Applications - Asset management, Industrial automation, smart grid, Commercial building automation, Smart cities - participatory sensing - Data Analytics for IoT – Software & Management Tools for IoT Cloud Storage Models & Communication APIs - Cloud for IoT - Amazon Web Services for IoT.		
Mapping of Course Outcomes for Unit VI	CO6	

Text Books:
1. Internet of Things – A hands-on approach, ArshdeepBahga, Vijay Madisetti, Universities Press, 2015.
2. Internet of Things: Architecture, Design Principles And Applications, Rajkamal, McGraw Hill Higher Education
3. Olivier Hersent, David Boswarthick, Omar Elloumi , —The Internet of Things – Key applications and Protocols, Wiley, 2012
4. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), —Architecting the Internet of Things, Springer, 2011.

Reference Books:
1. Rajkumar Buyya, Amir Vahid Dastjerdi Internet of Things – Principals and Paradigms, Morgan Kaufmann is an imprint of Elsevier, ISBN: 978-0-12-805395-9 Hakima Chaouchi, "The Internet of Things Connecting Objects to the Web" ISBN: 978-1- 84821-140-7, Willy Publications.
2. "From Machine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence", Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand. David Boyle and Elsevier, 2014.
3. Architecting the Internet of Things, Dieter Uckelmann, Mark Harrison, Michahelles and Florian (Eds), Springer, 2011.
4. Recipes to Begin, Expand, and Enhance Your Projects, 2nd Edition, Michael Margolis, Arduino Cookbook and O"Reilly Media, 2011.

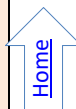| E Books / E Learning References : |
|---|
| https://nptel.ac.in/courses/106105195 |

Savitribai Phule Pune University, Pune
Third Year of Artificial Intelligence and Machine Learning (2020 Course)
318543: Web Technology

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory (TH) : 3 hrs/week	03 Credits	Mid_Semester : 30 Marks
		End_Semester : 70 Marks

Prerequisite Courses:---

Companion Course : 318547: WT Laboratory

Course Objectives:

- To familiarize students with Web Programming basic concepts
- To learn and understand Web scripting languages.
- To explore the Front end & Backend web programming skills.
- To understand and learn Mobile web development.
- To understand and learn Web application deployment

Course Outcomes:

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

CO1: Analyze behavior of web pages using web technologies

CO2: Develop Static and Dynamic website using technologies like HTML, CSS, Bootstrap

CO3: Demonstrate the use of web scripting languages

CO4: Develop web application with Front End & Back End Technologies

CO5: Develop mobile website using JQuery Mobile

CO6: Deploy web application on cloud using AWS

COURSE CONTENTS

Unit I	INTRODUCTION TO WEB TECHNOLOGIES	(06 hrs)

HTML: Getting started with HTML, Why HTML, Tags and Elements, Attributes, Properties, Headings list, Links, Tables, Images, HTML Form, Media (Audio, Video), Semantic HTML5 Elements.

CSS: Why CSS, Types of CSS, How to use CSS, Properties, Classes, Child-Class (Nested CSS), Colors, Text, Background, Border, Margin, Padding, Positioning (flex, grid, inline, block), Animation, Transition.

BOOTSTRAP: Why Bootstrap, CSS over Bootstrap, How to Use Bootstrap, Bootstrap Grid System, Bootstrap Responsive, Bootstrap Classes, Bootstrap Components (i.e., Button, Table, List, etc.), Bootstrap as a Cross Platform.

W3C: What is W3C, How W3C handles/Supports Web Technologies.

Mapping of Course Outcomes for Unit I	CO1, CO2

Unit II	WEB SCRIPTING LANGUAGES	(06 hrs)

JavaScript: Introduction to Scripting languages, Introduction to JavaScript (JS), JS Variables and Constants, JS Variable Scopes, JS Data Types, JS Functions, JS Array, JS Object, JS Events.

Advanced JavaScript: JSON - JSON Create, Key-Value Pair, JSON Access, JSON Array, JS Arrow Functions, JS Callback Functions, JS Promises, JS Async-Await Functions, JS Error Handling.

AJAX: Why AJAX, Call HTTP Methods Using AJAX, Data Sending, Data Receiving, AJAX Error Handling.

JQUERY: Why JQuery, How to Use, DOM Manipulation with JQuery, Dynamic Content Change with JQuery, UI Design Using JQuery.

Mapping of Course Outcomes for Unit II	CO3	
Unit III	**FRONT END TECHNOLOGIES**	**(06 hrs)**

Front-End Frameworks: What is web framework? Why Web Framework? Web Framework Types.
Model-View Controller: What is MVC, MVC Architecture, MVC in Practical, MVC in Web Frameworks.
TypeScript: Introduction to TypeScript (TS), Variables and Constants, Modules in TS.
AngularVersion 10+: Angular CLI, Angular Architecture, Angular Project Structure, Angular Lifecycle, Angular Modules, Angular Components, Angular Data Binding, Directives and Pipes, Angular Services and Dependency Injections (DI), Angular Routers, Angular Forms.
ReactJS: Introduction to ReactJS, React Components, Inter Components Communication, Components Styling, Routing, Redux- Architecture, Hooks- Basic hooks, useState() hook, useEffect() hook useContext() hook.

Mapping of Course Outcomes for Unit III	CO4	
Unit IV	**BACK END TECHNOLOGIES**	**(06 hrs)**

Node.JS: Introduction to Node.JS, Environment Setup, Node.JS Events, Node.JS Functions, Node.JS Built- in Modules, File System, NPM, Install External Modules, Handling Data I/O in Node.JS, Create HTTP Server, Create Socket Server, Micro services- PM2.
ExpressJS: Introduction to ExpressJS, Configure Routes, Template Engines, ExpressJS as Middleware, Serving Static Files, REST HTTP Method APIs, Applying Basic HTTP Authentication, Implement Session Authentication.
MongoDB: NoSQL and MongoDB Basics, MongoDB-Node.JS Communication, CRUD Operations using Node.JS, Mongoose ODM for Middleware, Advanced MongoDB.

Mapping of Course Outcomes for Unit IV	CO4	
Unit V	**MOBILE WEB DEVELOPMENT**	**(06 hrs)**

Mobile-First: What is Mobile-First? What is Mobile Web? Understanding Mobile Devices and Desktop.
JQuery Mobile: Introduction to the jQuery Mobile Framework, Set-up jQuery Mobile, Pages, Icons, Transitions, Layouts Widgets, Events, Forms, Themes, Formatting Lists, Header and Footer, CSS Classes, Data Attributes, Building a Simple Mobile Webpage

Mapping of Course Outcomes for Unit V	CO5	
Unit VI	**WEB APPLICATION DEPLOYMENT**	**(06 hrs)**

Cloud: AWS Cloud, AWS Elastic Compute, AWS Elastic Load Balancer and its types, AWS VPC and Component of VPC, AWS storage, Deploy Website or Web Application on AWS, Launch an Application with AWS Elastic Beanstalk.

Mapping of Course Outcomes for Unit VI	CO6	

Text Books:
1. Kogent Learning Solutions Inc, Web Technologies: HTML, JAVASCRIPT, PHP, JAVA, JSP, XML and AJAX, Blackbook, Dreamtech Press, Second Edition, ISBN: 9788177228496.
2. Raymond Camden, Andy Matthews, JQuery Mobile Web Development Essentials, Packt Publishing, Second Edition, 9781782167891.
Reference Books:
1. Steven M. Schafer, "HTML, XHTML and CSS", Wiley India Edition, Fourth Edition,978- 81- 265-1635-3
2. Dr.Hiren Joshi, Web Technology and Application Development, DreamTech, First,ISBN:978-93-5004-088-1
3. Steven M. Schafer, "HTML, XHTML and CSS", Wiley India Edition, Fourth Edition,978- 81-265-1635-3
4. Ivan Bayross, "Web Enabled Commercial Application Development Using HTML, JavaScript, DHTML and PHP, BPB Publications,4th Edition, ISBN:978-8183330084.
5. Brain Fling, Mobile Design and Development, O'REILLY, First Edition, ISBN: 13:978-81- 8404-817-9
6. Adam Bretz& Colin J Ihrig, Full Stack Javascript Development with MEAN, SPD, First Edition, ISBN:978-0992461256.
7. JavaScript: The Definitive Guide - Master The World's Most-Used Programming Language, Seventh Edition
8. Java Script, D.Flanagan, O'Reilly, SPD.
9. Programming Typescript: Making Your JavaScript Applications Scale, Boris Cherny
E Books / E Learning References :
1. Learning Amazon Web Services AWS - A Hands-on Guide to the Fundamentals of AWS Cloud Author: Mark Wilkins.
2. https://www.meanacademy.in/web-technologies
3. https://www.javaguides.net/2020/07/angular-10-example-tutorial.htm

Savitribai Phule Pune University, Pune **Third Year of Artificial Intelligence and Machine Learning (2020 Course)** **318544: Management and Entrepreneurship for IT Industry**	

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory (TH) : 03/week	03 Credits	Mid_Semester : 30 Marks End_Semester :70 Marks

Prerequisite Courses: if any:----

Companion Course : if any:----

Course Objectives:
- Explain the principles of management, organization and entrepreneur.
- Discuss on planning, staffing, ERP and their importance
- Infer the importance of intellectual property rights and relate the institutional support

Course Outcomes:

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

CO1: Define management, organization, entrepreneur, planning, staffing, ERP and outline their importance in entrepreneurship

CO2: Utilize the resources available effectively through ERP

CO3: Make use of IPRs and institutional support in entrepreneurship

CO4: Understand the role of entrepreneurs in economic development, and barriers, Identification of business opportunities, feasibility studies.

CO5: Understand the contents of project report, ERP and project.

CO6: Understand IPRs and institutional support in entrepreneurship, Case Study of Entrepreneurs.

CO7: Learners will explore entrepreneurial skills and management function of a company with special reference to SME sector.

COURSE CONTENTS		
Unit I	**INTRODUCTION**	**(10hrs)**

Meaning, nature and characteristics of management, scope and Functional areas of management, goals of management, levels of management, brief overview of evolution of management theories,. Planning- Nature, importance, types of plans, steps in planning, Organizing- nature and purpose, types of Organization, Staffing- meaning, process of recruitment and selection.

Mapping of Course Outcomes for Unit I	CO1, CO2

Unit II	**DIRECTING AND CONTROLLING**	**(10 hrs)**

Meaning and nature of directing, leadership styles, motivation Theories, Communication- Meaning and importance, Coordination meaning and importance, Controlling- meaning, steps in controlling, methods of establishing control.
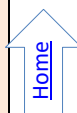
Mapping of Course Outcomes for Unit II	CO3	
Unit III	**ENTREPRENEUR**	**(6 hrs)**
Meaning of entrepreneur, characteristics of entrepreneurs, classification and types of entrepreneurs, various stages in entrepreneurial process, role of entrepreneurs in economic development, entrepreneurship in India and barriers to entrepreneurship. Identification of business opportunities, market feasibility study, technical feasibility study, financial feasibility study and social feasibility study.		
Mapping of Course Outcomes for Unit III	CO4	
Unit IV	**PREPARATION OF PROJECT AND ERP**	**(6 hrs)**
Meaning of project, project identification, project selection, project report, need and significance of project report, contents, formulation, guidelines by planning commission for project report, Enterprise Resource Planning: Meaning and Importance- ERP and Functional areas of Management – Marketing / Sales- Supply Chain Management – Finance and Accounting – Human Resources – Types of reports and methods of report generation.		
Mapping of Course Outcomes for Unit IV	CO4	
Unit V	**MICRO AND SMALL ENTERPRISES**	**(6 hrs)**
Definition of micro and small enterprises, characteristics and advantages of micro and small enterprises, steps in establishing micro and small enterprises, Government of India indusial policy 2007 on micro and small enterprises, case study (Microsoft), Case study(Captain G R Gopinath),case study (N R Narayana Murthy & Infosys), Institutional support: MSME-DI, NSIC, SIDBI, KIADB, KSSIDC, TECSOK, KSFC, DIC and District level single window agency.		
Mapping of Course Outcomes for Unit V	CO5	
Unit VI	**INTRODUCTION TO IPR**	**(6 hrs)**
Introduction to Intellectual Property Rights Concept and Theories Kinds of Intellectual Property Rights Economic analysis of Intellectual Property Rights Need for Private Rights versus Public Interests Advantages and Disadvantages of IPR. Criticisms of Intellectual Property Rights Politics of Intellectual Property Rights Third World Criticisms Marxist Criticisms International Regime Relating to IPR TRIPS and other Treaties (WIPO,WTO, GATTS).		
Mapping of Course Outcomes for Unit VI	CO6	

Text Books:
1. D.P. Mittal (Taxman Publication), Indian Patents Law and Procedure
2. B.L. Wadera, Patents, trademarks, copyright, Designs and Geographical Judications.
3. P. Narayanan (Eastern Law House), Intellectual Property Law
4. N.S. Gopalakrishnan & T.G. Agitha, Principles of Intellectual Property (2009), Eastern Book Company, Lucknow
5. Principles of Management -P. C. Tripathi, P. N. Reddy; Tata McGraw Hill, 4th / 6th Edition, 2010.
6. Dynamics of Entrepreneurial Development & Management -Vasant Desai Himalaya Publishing House.
7. Entrepreneurship Development -Small Business Enterprises -Poornima M Charantimath Pearson Education – 2006.
8. Management and Entrepreneurship – Kanishka Bedi- Oxford University Press-2017

Reference Books:
1. Management Fundamentals -Concepts, Application, Skill Development Robert Lusier – Thomson.
2. Entrepreneurship Development -S S Khanka -S Chand & Co.
3. Management -Stephen Robbins -Pearson Education /PHI -17th Edition, 2003

E Books / E Learning References :
1. https://ediindia.ac.in/
2. https://www.ehl.edu/
3. https://www.edx.org/learn/entrepreneurship
4. https://www.coursera.org/browse/business/entrepreneurship

Savitribai Phule Pune University, Pune
Third Year of Artificial Intelligence and Machine Learning (2020 Course)
318545 : Elective-I-(A): Robotics

Home

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory (TH) : 3 hrs/week	**03 Credits**	**Mid_Semester : 30 Marks** **End_Semester : 70 Marks**

Prerequisite Courses: Engineering Mechanisms and their Application, Introduction to Manufacturing, Matrices, Vectors, Electrical Technology, Industrial Electronics
Companion Course : if any:----
Course Objectives:
1.To introduce various types of Robots and the functional elements of Robotics
2. To impart knowledge of robot drive systems
3. To introduce various types the end effectors
4. To educate on various sensors used in Robotic automation
5. To introduce the basic mechanical modeling of a robot
6. To impart knowledge of basics of Robot Programming and robotic Applications
Course Outcomes:
On completion of the course, students will be able to– **CO1:** Understand basic concepts of robotics. **CO2:** Select appropriate Components and can able to do basic modeling & drive for Robotic applications. **CO3:** Understand Kinematics and transformations. **CO4:** Compare and select robot and end effectors, Sensors, grippers as per application **CO5:** Know about the fundamentals of robot programming and applications **CO6:** Study coverage of application and issues in Future in Robotics
COURSE CONTENTS

Unit I	INTRODUCTION: OVERVIEW OF ROBOTS	(08 hrs)

Robots Historical Perspective, Robot Anatomy, Basic Components of Robots, Function of Robots System, Specifications of robots System, Introduction to Robots-Cylindrical ,Spherical, Articulated, Basics of industrial Robot, Robots Classification, major Components of Robots, Fixed Vs flexible Automation,Robotperformance-Resolution,Accuracy,Repeatability,Dexterity,Compliance, RCC Device, Sociological Consequences of robots, State of art Survey, Robotics Applications-Current, Future.

Case Study	Allied Automation with SCARA Robot
Mapping of Course Outcomes for Unit I	CO1

Unit II	MECHANICAL SYSTEMS: COMPONENTS, DYNAMICS AND MODELING	(08 hrs)
Objectives, motivation, review of Elementary mechanical Concepts, translation or linear motion, Rotational motion, mechanical work and power. Motion Conversion-Rotary to rotary, Rotary to linear, linkages Couplers, Some problem with real world Components and Modelling of mechanical Systems. Drives: Type of Drives, Actuators and its selection while designing robot system, type of controllers, Control law of portioning, force control.		
Case Study	Motor Selection in the design of Robotics joints	
Mapping of Course Outcomes for Unit II	CO2	

Unit III	TRANSFORMATIONS AND KINEMATICS	(09 hrs)
Homogeneous Coordinates, Vector Operations, Matrix Operators, Coordinate Reference Frames, Some Properties of Transformation Matrices, homogeneous transformations and Manipulator in detail, Establishing link Coordinate frames, the Denavit-Hartenberg Matrix, Comments on Forming the Forward Solution, The inverse or Back Solution with problems, techniques of obtaining Inverse Solution, Motion Generation, Controller Architecture		
Case Study	safety, training, maintenance & Quality of robots	
Mapping of Course Outcomes for Unit III	CO3	

Unit IV	ROBOT EFFECTORS	(08 hrs)
Gripper types, Design Aspect for gripper, Force analysis for various basic gripper systems including mechanical, Hydraulic and Pneumatic systems, Types of End effectors, Mechanical gripper, tools as end effectors. Sensors Type, Sensors in Robotics, Tactile Sensors, Proximity and rage sensors, Miscellaneous Sensors and Sensor-Based Systems, Uses of Sensors in Robotics.		
Case Study	Social issues of Future Robotics	
Mapping of Course Outcomes for Unit IV	CO4	

Unit V	COMPUTER CONSIDERATIONS FOR ROBOTICS	(07 hrs)
Architectural Considerations, Hardware Considerations, Computational elements in Robotic Applications-Control, Communication, calculation, Coordination Functionalities, real time Consideration, Path planning. Robot programming-Summary of Languages (Al, AML, RAIL, RPL, Val) Sample programs, Robot Control Sequencing, Demonstration of points in Space, Artificial intelligence and Robot Programming.		
Case Study	Digital Control of Single Axis	
Mapping of Course Outcomes for Unit V	CO5	

Unit VI	APPLICATIONS AND FUTURE OF ROBOTICS	(07 hrs)

Applications Material Transfer and machine loading/Unloading, Processing Operations(Welding, Coating),Assembly and Inspection,

Social Issues Social and Labor Issues-Productivity and capital Formation, Robotics and labor, Education and Training, International impacts.

Robotics technology of the Future Applications-Characteristics of future robot task, Future Manufacturing, Hazardous and Inaccessible Nonmanufacturing Environments, Service Industry and Similar Applications.

Case Study	**Robotics technology in the Future**
Mapping of Course Outcomes for Unit VI	CO6

Text Books:

1. Richard D. Klafter, Thomas A. Chmielewski, Michael Negin,"Robotic Engineering-An Integrated Approach", Prentice Hall, ISBN 81-203-0842-5.
2. Mikell P. Groover, Mitchell Weiss, Roger N. Nagel, Nicholas G. Odrey, "Industrial Robotics-technology , Programming and Applications", Tata McGraw-Hill, ISBN 13: 978-0-07-026509-7,ISBN 10:0-07-026509-7.

Reference Books:

1. K.S. Fu, R. C. Gonzalez, C.S.G. Lee, "Robotics-control, Sensing, Vision and Intelligence", Tata McGraw-Hill, ISBN 13:978-0-07-026510-3, ISBN 0-07-026510-0.
2. Saeed B. Niku, "Introduction to Robotics-Analysis, Control, Applications", WILEY, Second Edition, ISBN 978-81-265-3312-1
3. John Craig, Introduction to Robotics, Mechanics and Control, 3rd Edition, Pearson Education, 2009
4. R K Mittal & I. J. Nagrath, Robotics and Control, McGraw Hill Publication, 2015.
5. www.roboanalyser.com

E Books / E learning Reference:

NPTEL:

1. https://archive.nptel.ac.in/courses/112/104/112104298/
2. https://archive.nptel.ac.in/courses/107/106/107106090/
3. https://archive.nptel.ac.in/courses/112/105/112105249/
4. https://archive.nptel.ac.in/courses/112/101/112101098/
5. https://archive.nptel.ac.in/courses/112/104/112104293/

Virtual Labs:
1. https://vlab.amrita.edu/?sub=62&brch=271
2. http://vlabs.iitkgp.ernet.in/mr/
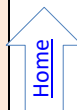
Courses Available:

1. https://trainings.internshala.com/robotic-process-automation-training/?utm_source=is_web_internshala-menu-dropdown
2. https://trainings.internshala.com/arduino-course/?utm_source=is_web_internshala-menu-dropdown

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Savitribai Phule Pune University, Pune
Third Year of Artificial Intelligence and Machine Learning (2020 Course)
318545 : Elective-I-(B): Pattern Recognition

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Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory (TH) : 3 hrs/week	03 Credits	Mid_Semester : 30 Marks End_Semester : 70 Marks

Prerequisite Courses: Image Processing

Companion Course : if any:----

Course Objectives:

- To Implement pattern recognition techniques which include automatic speech recognition
- To Classify the text into several categories (e.g., spam/non-spam email messages)
- To Understand the recognition of handwritten postal codes on postal envelopes
- To Understand an Automatic recognition of images of human faces
- To learn Handwriting image extraction from medical

Course Outcomes:

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

CO1: Understand Bayesian Decision Theory, the canonical classifier model, and how different classification methods define decision boundaries.
CO2: Estimate unknown Probability Density functions
CO3: Apply performance evaluation methods for pattern recognition and understand about the clustering concepts.
CO4: Select appropriate techniques for addressing recognition problems.
CO5: Implement basic pattern recognition algorithms
CO6: Summarize current pattern recognition research verbally and in writing and analyze the estimation methods.

COURSE CONTENTS		
Unit I	**INTRODUCTION TO PATTERN RECOGNITION**	**(08 hrs)**

Importance of pattern recognition, Features, Feature Vectors, and Classifiers, Supervised, Unsupervised, and Semi-supervised learning, Introduction to Bayes Decision Theory, Discriminant Functions and Decision Surfaces, Gaussian PDF and Bayesian Classification for Normal Distributions

Mapping of Course Outcomes for Unit I	CO1,CO4

Unit II	DATA TRANSFORMATION AND DIMENSIONALITY REDUCTION INTRODUCTION	(08 hrs)
Basis Vectors, The KarhunenLoeve (KL) Transformation, Singular Value Decomposition, Independent Component Analysis (Introduction only). Nonlinear Dimensionality Reduction, Kernel PCA.		
Mapping of Course Outcomes for Unit II	CO2,CO3	
Unit III	ESTIMATION OF UNKNOWN PROBABILITY DENSITY FUNCTIONS	(09 hrs)
Maximum Likelihood Parameter Estimation, Maximum a Posteriori Probability estimation, Bayesian Interference, Maximum Entropy Estimation, Mixture Models, Naive-Bayes Classifier, The Nearest Neighbor Rule.		
Mapping of Course Outcomes for Unit III	CO2	
Unit IV	LINEAR CLASSIFIERS	(08 hrs)
Introduction, Linear Discriminant Functions and Decision Hyperplanes, The Perceptron Algorithm, Mean Square Error Estimate, Stochastic Approximation of LMS Algorithm, Sum of Error Estimate.		
Mapping of Course Outcomes for Unit IV	CO3 ,CO4	
Unit V	NONLINEAR CLASSIFIERS	(07 hrs)
The XOR Problem, The two Layer Perceptron, Three Layer Perceptron, Back propagation Algorithm, Basic Concepts of Clustering, Introduction to Clustering , Clustering Algorithms: Sequential and Hierarchical algorithms, Proximity Measures.		
Mapping of Course Outcomes for Unit V	CO3,CO6	
Unit VI	STATISTICAL PATTEN RECOGNITION	(07 hrs)
Bayesian Decision Theory, Classifiers, Normal density and discriminant functions, Parameter estimation methods: Maximum-Likelihood estimation, Bayesian Parameter estimation, Dimension reduction methods – Principal Component Analysis (PCA), Fisher Linear discriminant analysis, Expectation-maximization (EM), Hidden Markov Models (HMM),Gaussian mixture models.		
Mapping of Course Outcomes for Unit VI	CO6	

Text Books
1. Pattern Recognition by Sergios Theodoridis and Konstantinos Koutroumbas,Elsevier
2. PatternRecognitionStatistical,Structural and Neural Approaches by Robert Schalkoff,Wiley
3. Pattern Recognition and Machine Leaming by Christopher Bishop,Springer
Reference Books
1. Pattern Recognition And machine learning by Christopher M. Bishop
2. Pattern Recognition Principal by R. C. Gonzalez
E Books / E learning reference
1. Pattern Recognition And machine learning by Christopher M. Bishop

	Savitribai Phule Pune University, Pune

Savitribai Phule Pune University, Pune
Third Year of Artificial Intelligence and Machine Learning (2020 Course)
318545 : Elective-I-(C): Information Security

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory (TH) : 3 hrs/week	03 Credits	Mid_Semester : 30 Marks End_Semester : 70 Marks

Prerequisite Courses: ---

Course Objectives:

- To understand the fundamental approaches, principles and apply these concepts in Information Security
- To acquire the knowledge of mathematics for cryptography, understand the concepts of basic cryptography
- To learn standard algorithms and protocols employed to provide confidentiality, integrity and authenticity
- To acquire the knowledge of security protocol deployed in web security
- To study Information Security tools

Course Outcomes:

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

CO1: Model the cyber security threats and apply formal procedures to defend the attacks.

CO2: Apply appropriate cryptographic techniques by learning symmetric key cryptography.

CO3: Apply appropriate cryptographic techniques by learning asymmetric key cryptography.

CO4: Design and analyze web security solutions by deploying various cryptographic techniques along with data integrity algorithms.

CO5: Identify and Evaluate Information Security threats and vulnerabilities in Information systems and apply security measures to real time scenarios.

CO6: Demonstrate the use of standards and cyber laws to enhance Information Security in the development process and infrastructure protection.

COURSE CONTENTS		
Unit I	INTRODUCTION TO INFORMATION SECURITY	(06 hrs)

Foundations of Security: Computer Security Concepts, The OSI Security Architecture, and Security attacks, Security services, Security mechanism, A Model for Network Security.

Exemplar/Case Studies	Open Source/ Free/ Trial Tools: Clam AV antivirus engine, Anti Phishing, Anti Spyware, Wireshark.
Mapping of Course Outcomes for Unit I	CO1

Unit II	SYMMETRIC KEY CRYPTOGRAPHY	(06 hrs)

Classical Encryption Techniques: Stream Ciphers, Substitution Techniques: Caesar Cipher, Mono alphabetic Ciphers, Play fair Cipher, Hill Cipher, Poly alphabetic Ciphers, Transposition Techniques, Block Ciphers and Data Encryption standards, 3DES, Advanced Encryption standard.

Exemplar/Case Studies	Open Source/ Free/ Trial Tools: crypt tool
Mapping of Course Outcomes for Unit II	CO2

Unit III	ASYMMETRIC KEY CRYPTOGRAPHY	(06 hrs)

Number theory: Prime number, Fermat and Euler theorems , Testing for primality, Chinese reminder theorem, discrete logarithm, Public Key Cryptography and RSA, Key Management, Diffie- Hellman key exchange, El Gamal algorithm, Elliptic Curve Cryptography

Mapping of Course Outcomes for Unit III	CO3

Unit IV	DATA INTEGRITY ALGORITHMS AND WEB SECURITY	(07 hrs)

Cryptographic Hash Functions: Applications of Cryptographic Hash Functions, Two Simple Hash Functions, Requirements and Security, Hash Functions Based on Cipher Block Chaining, Secure Hash Algorithm (SHA), SHA-3, MD4, MD5. **Message Authentication Codes**: Message Authentication Requirements, Message Authentication Functions, Requirements for Message Authentication Codes, Security of MACs. **Digital Signatures**: Digital Signatures, Schemes, Digital Signature standard, PKI X.509 Certificate.
Web Security issues, HTTPS, SSH, Email security: PGP, S/MIME, IP Security : IPSec

Exemplar/Case Studies	Open Source/ Free/ Trial Tools: OpenSSL, Hash Calculator Tool : MD5, SHA1, SHA256, SHA 512
Mapping of Course Outcomes for Unit IV	CO4

Unit V	NETWORK AND SYSTEM SECURITY	(06 hrs)

The OSI Security architecture, Access Control, Flooding attacks, DOS, Distributed DOS attacks Intrusion detection, Host based and network based Honeypot, Firewall and Intrusion prevention system, Need of firewall, Firewall characteristics and access policy, Types of Firewall, DMZ networks, Intrusion prevention system: Host based, Network based, Hybrid.
Operating system Security, Application Security, Security maintenance, Multilevel Security, Multilevel Security for role based access control, Concepts of trusted system, Trusted computing.

Exemplar/Case Studies	Open Source/ Free/ Trial Tools: DOS attacks, DOS attacks, Wireshark, Cain and Abel, iptables/ Windows Firewall, Suricata, fail2ban, Snort.

Mapping of Course Outcomes for Unit V	CO5	
Unit VI	**CYBER SECURITY AND TOOLS**	**(5 hrs)**

Introduction: Cybercrime and Information Security, Classification of Cybercrimes, The legal perspectives-Indian perspective, Global perspective, Categories of Cybercrime, Social Engineering, Cyber stalking, Proxy servers and Anonymizers, Phishing, Password Cracking, Key-loggers and Spywares, The Indian IT Act-Challenges, Amendments, Challenges to Indian Law and Cybercrime Scenario in India, Indian IT Act.

Exemplar/Case Studies	Study of any two network security scanners: Nmap, Metasploit, Open VAS, Aircrack,Nikito,Samurai,Safe3etc
Mapping of Course Outcomes for Unit VI	**CO6**

Text Books:

1. William Stallings, "Cryptography and Network Security Principals and Practice", Seventh edition, Pearson , ISBN : 978-1-292-15858
2. William Stallings, Lawrie Brown, "Computer Security Principles and Practice", 3rd_Edition, Pearson , ISBN : 978-0-13-3777392-7
3. Nina Godbole, Sumit Belapure, "Cyber Security", Wiley, ISBN: 978-81-265-2179-1

Reference Books:

1. Atul Kahate, "Cryptography and Network Security", 3e, McGraw Hill Education
2. V.K. Pachghare, "Cryptography and Information Security", PHI Learning
3. Bernard Menezes, "Network Security and Cryptography", Cengage Learning India, 2014, ISBN No.: 8131513491
4. Josheph Kizza, "Computer Network Security and Cyber Ethics", McFarland & Company, Inc., Publishers , Fourth Edition
5. Michael Whitman and Herbert Matford, "Principles of Information Security", Course Technology Ink, 7th edition
6. Neena Godbole, "Information Systems Security, 2ed: Security Management, Metrics,
7. Frameworks and Best Practices" , Wiley publication, ISBN: 9788126564057

E Books / E Learning References :

E Books:
1. Introduction to Cyber Security, "http://www.uou.ac.in/sites/default/files/slm/FCS.pdf ", by Dr. Jeetendra Pande | Uttarakhand Open University, Haldwani
2. "Information Security, The complete reference", Second Edition, Mark Rhodes-Ousley, McGrawHill

MOOCs Courses link:
1. NPTEL course on https://nptel.ac.in/courses/106/106/106106129/ (IIT Madras, Prof. V. Kamakoti)
2. Introduction to cyber security, "https://swayam.gov.in/nd2_nou19_cs08/preview" by Dr. Jeetendra Pande | Uttarakhand Open University, Haldwani

Savitribai Phule Pune University, Pune
Third Year of Artificial Intelligence and Machine Learning (2020 Course)
318545: Elective I (D): Business Intelligence

Home

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory (TH) : 3 hrs/week	**03**	**Mid_Semester : 30 Marks** **End_Semester : 70 Marks**

Prerequisite Courses, if any: DBMS

Companion Course, if any: Data mining

Course Objectives:

- Apply conceptual knowledge on how Business Intelligence is used within organizations.
- Explore various systems and software for Business Intelligence
- Understand several business scenarios where business analytics and intelligence can be useful
- Understand the mathematical and analytical models behind Business Intelligence

Course Outcomes:

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

CO1: Apply conceptual knowledge on how Business Intelligence is used in decision making process

CO2: Use modelling concepts in Business Intelligence

CO3: Understand and apply the concepts of business reports and analytics with the help of visualization for business performance management

CO4: Comprehend the model based decision making using prescriptive analytics

CO5: Analyze the role of analytics and intelligence in Business

CO6: Comprehend different Business Intelligence trends and its future impacts

COURSE CONTENTS

Unit I	**Introduction to Decision Making and Business Intelligence**	**(07 hrs)**

Changing Business Environments, Decision Making & Simon's Decision Making Process, Managerial roles in Decision Making, Information Systems Support for Decision Making, framework for Computerized Decision Support: The Gorry and Scott-Morton Classical Framework, Decision support systems (DSS). Capabilities of DSS, DSS Classification, DSS Components.

Business Intelligence (BI), Framework for BI, BI architecture, DSS - BI Connection, Goals of Business Intelligence, Business Intelligence: Tasks and Analysis Formats, BI use cases: Application in Patient Treatment, Application in Higher Education, Application in Logistics

Mapping of Course Outcomes for Unit I	CO1

Unit II	**Modeling in BI**	**(07 hrs)**

Models and Modeling in BI, Model Presentation, Model Building, Model Assessment and Quality of Models, Modeling using Logical Structures: Ontologies & Frames, Modeling using Graph Structures : Business Process Model and Notation (BPMN) & Petri Nets, Modeling using Probabilistic Structures, Modeling Using Analytical Structures. Models and Data: Data Generation, The Role of Time, Data Quality.

Mapping of Course Outcomes for Unit II	CO2	
Unit III	**Business reporting, Visual analytics and Performance management**	**(07 hrs)**

What Is a Business Report, Components of Business Reporting Systems, Data and Information Visualization, Types of Charts and Graphs, Visual Analytics, Performance Dashboards, Business Performance Management, Closed Loop BPM Cycle, Performance Measurement, Key Performance Indicators, Balanced Scorecards, The Four Perspectives of BSC.

BI Tools: Tableau, Qlik, power BI, Dundas BI, Sisense, Webfocus, Oracle BI.

Mapping of Course Outcomes for Unit III	CO3	
Unit IV	**Prescriptive Analytics & Model-Based Decision Making**	**(07 hrs)**

What are Descriptive analytics, predictive analytics, and prescriptive analytics, Decision Support Systems Modeling, Structure of Mathematical Models for Decision Support, Certainty, Uncertainty, and Risk, Decision Modeling with Spreadsheets, Mathematical Programming Optimization, Multiple Goals, Sensitivity Analysis, What-If Analysis, and Goal Seeking, Decision Analysis with Decision Tables and Decision Trees, Multi-criteria Decision Making With Pairwise Comparisons.

Mapping of Course Outcomes for Unit IV	CO4	
Unit V	**Role of Analytics and Intelligence in Business**	**(06 hrs)**

The role of visual and business analytics (BA) in BI and how various forms of BA are supported in practice. ERP and Business Intelligence, BI Applications in CRM, BI Applications in Marketing, BI Applications in Logistics and Production, Role of BI in Finance, BI Applications in Banking, BI Applications in Telecommunications, BI Applications in Fraud Detection, BI Applications in Retail Industry.

Mapping of Course Outcomes for Unit V	CO5	
Unit VI	**Business Analytics: Emerging Trends and Future Impacts**	**(06 hrs)**

Emerging Technologies, the critical success factors for implementing a BI strategy, Predicting the Future with the help of Data Analysis, BI Search & Text Analytics – Advanced Visualization – Rich Report, cloud computing and BI, Future beyond Technology. Impacts of Analytics in Organizations, Issues of Legality, Privacy, and Ethics, Location-Based Analytics for Organizations, Analytics Applications for Consumers.

Mapping of Course Outcomes for Unit VI	CO6	

Text Books:
1. Wilfried Grossmann & Stefanie Rinderle-Ma "Fundamentals of Business Intelligence", Springer, ISBN 978-3-662-46531-8 (eBook)
2. Business Intelligence and Analytics: Systems for Decision Support, 10th edition, ISBN 978-0-133-05090-5, by Ramesh Sharda, Dursun Delen, and Efraim Turban, published by Pearson Education © 2014.
Reference Books:
1. Sabherwal, R. and Becerra-Fernandez, I. (2011). Business Intelligence: Practices, Technologies and Management. John Wiley.
2. Turban,E. and Volonino, L.(2011). Information Technology for Managment: Improving Strategic and Operational Performance. 8th edn.Wiley.
E Books / E Learning References :
1.https://www2.deloitte.com/us/en/pages/deloitte-analytics/articles/business-analytics-case-studies.html.
2. https://www.blastanalytics.com/analytics-case-studies
3. BI Foundations with SQL, ETL and Data Warehousing Specialization (Coursera)

Savitribai Phule Pune University, Pune Third Year of Artificial Intelligence and Machine Learning (2020 Course) **318546: Software Laboratory I (IoT with Artificial Intelligence)**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical (PR) : 04hrs/week	**02 Credits**	**PR : 25 Marks** **TW : 25Marks**

Prerequisites: Basic : Basic Electronics Engineering (104010), Computer Programming

Course Objectives :

- Hardware platforms and operating systems commonly used in IoT systems.
- Help the students in providing a good learning environment and also work with real time problems faced in day to day life.

Course Outcomes :

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

CO1: Understand IOT Application Development using Raspberry Pi/ Beagle board/ Arduino board
CO2: Develop and modify the code for various sensor based applications using wireless sensor modules and working with a variety of modules like environmental modules.
CO3: Make use of Cloud platform to upload and analyze any sensor data

Guidelines for Instructor's Manual

The faculty member should prepare the laboratory manual for all the experiments and it should be made available to students and laboratory instructor/Assistant.

Guidelines for Student's Lab Journal

1. Student should submit term work in the form of journal with write-ups based on specified list of assignments.
2. Practical and Oral Examination will be based on all the assignments in the lab manual
3. Candidate is expected to know the theory involved in the experiment.
4. The practical examination should be conducted if and only if the journal of the candidate is complete in all respects.

Guidelines for Lab /TW Assessment

1. Examiners will assess the student based on performance of students considering the parameters such as timely conduction of practical assignment, methodology adopted for implementation of practical assignment, timely submission of assignment in the form of writeups along with results of implemented assignment, attendance etc.
2. Examiners will judge the understanding of the practical performed in the examination by asking some questions related to theory & implementation of experiments he/she has carried out.
3. Appropriate knowledge of usage of software related to respective laboratory should be checked by the concerned faculty member.

Guidelines for Laboratory Conduction

Following is list of suggested laboratory assignments 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 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. 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. 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.

Guidelines for Practical Examination
1. There will be 2 problem statements options and student will have to perform any one.
2. All the problem statements carry equal weightage.

List of Laboratory Assignments
Suggested List of Laboratory Experiments/Assignments
• Student should perform all assignments from Group A, Any 6 assignments from group B and any 1 assignment from Group C. (Use suitable programming language/Tool for implementation)

Group A (All Mandatory)
1. Study of Raspberry-Pi/ Beagle board/ Arduino and other microcontroller (History & Elevation)
2. Study of different operating systems for Raspberry-Pi /Beagle board/Arduino. Understanding the process of OS installation
3. Write an application to read temperature from the environment. If temperature crosses threshold value then it notifies with buzzer

Group B (Any 6)
4. Write a program using Arduino to control LED (One or more ON/OFF). Or Blinking.
5. Create a program so that when the user enters 'b' the green light blinks, 'g' the green light is illuminated 'y' the yellow light is illuminated and 'r' the red light is illuminated.
6. Write a program that asks the user for a number and outputs the number squared that is entered.
7. Write a program to control the color of the LED by turning 3 different potentiometers. One will be read for the value of Red, one for the value of Green, and one for the value of Blue.
8. Write a program read the temperature sensor and send the values to the serial monitor on the computer.
9. Write a program so it displays the temperature in Fahrenheit as well as the maximum and minimum temperatures it has seen.
10. Write a program to show the temperature and shows a graph of the recent measurements.
11. Write a program using piezo element and use it to play a tune after someone knocks.
12. Write an application using Raspberry Pi/Arduino for smart health monitoring system which records heart beat rate and temperature and also sends sms alerts if readings are beyond critical values.

Group C (Any One)
13. Study of ThingSpeak – an API and Web Service for the Internet of Things.
14. Write an application to control the operation of hardware simulated traffic signals.
15. Develop a Real time application like smart home with following requirements: When the user enters into the house the required appliances like fan, light should be switched ON. Appliances should also get controlled remotely by a suitable web interface. The objective of this application is that students should construct complete Smart applications in groups.
16. Write an application for stopwatch or countdown timer.

Reference Books:
1. Alan G. Smith, " Introduction to Arduino: A piece of cake"

2. Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective", CRC Press, 2012. ISBN : 9781439892992.

3. Olivier Hersent, Omar Elloumi and David Boswarthick, "The Internet of Things: Applications to the Smart Grid and Building Automation", Wiley, 2012, 97811199583453.

4. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things: Key applications and Protocols", Wiley, 2012,ISBN:978-1-119-99435-0

Savitribai Phule Pune University, Pune		
Third Year of Artificial Intelligence and Machine Learning (2020 Course)		
318547: WT Laboratory		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical (PR) : 02 hrs/week	**1 Credit**	**PR : 25 Marks** **TW : 25 Marks**

Prerequisites: Programming languages C++, Java

Course Objectives :
- To understand basic concepts of web programming and scripting languages.
- To learn Version Control Environment.
- To learn front end technologies and back end technologies.
- To understand mobile web development.
- To comprehend web application deployment.

Course Outcomes :

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

CO1: Develop Static and Dynamic responsive website using technologies HTML, CSS, Bootstrap and AJAX.

CO2: Create Version Control Environment.

CO3: Develop an application using front end and backend technologies.

CO4: Develop mobile website using JQuery Mobile.

CO5: Deploy web application on cloud using AWS.

Guidelines for Instructor's Manual

Lab Assignments: Following is a list of suggested laboratory assignments for reference. Laboratory Instructors may design a suitable set of assignments for their respective courses at their level. Beyond curriculum assignments, the mini-project is also 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. 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).

Guidelines for Student's Lab 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 journals may be avoided. Submission of journal/ term work in the form of softcopy is desirable and appreciated.

Guidelines for Lab /TW Assessment

Term work is continuous assessment that evaluates a student's progress throughout the semester. 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 an internal monthly practical examination as part of continuous assessment.

Guidelines for Laboratory Conduction
Following is a list of suggested laboratory assignments for reference. Laboratory Instructors may design a suitable set of assignments for respective courses at their level. Beyond curriculum assignments and mini-project may be included as a part of laboratory work. 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. 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. 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 tutorials may be as per guidelines of authority.
Guidelines for Practical Examination
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.
List of Laboratory Assignments
Group A

Assignment 1 :
Create a responsive web page which shows the ecommerce/college/exam admin dashboard with sidebar and statistics in cards using HTML, CSS and Bootstrap.

Assignment 2:
Write a JavaScript Program to get the user registration data and push to array/local storage with AJAX POST method and data list in new page.

Assignment 3:
   a. Create version control account on GitHub and using Git commands to create repository and push your code to GitHub.
   b. Create Docker Container Environment (NVIDEIA Docker or any other).
   c. Create an Angular application which will do following actions: Register User, Login User, Show User Data on Profile Component

Assignment 4 :
   a. Create a Node.JS Application which serves a static website.
   b. Create four API using Node.JS, ExpressJS and MongoDB for CURD Operations on assignment 3.C.

Assignment 5:
   a. Create a simple Mobile Website using jQuery Mobile.
   b. Deploy/Host your web application on AWS VPC or AWS Elastic Beanstalk.

Assignment 6: Mini Project
   Develop a web application using full stack development technologies in any of the following domains:
      1. Social Media
      2. ecommerce

3. Restaurant 4. Medical 5. Finance 6. Education 7. Any other
Reference Books:
1. Kogent Learning Solutions Inc, Web Technologies: HTML, JAVASCRIPT, PHP, JAVA, JSP, XML and AJAX, Blackbook, Dreamtech Press, Second Edition, ISBN: 9788177228496. 2. Raymond Camden, Andy Matthews, jQuery Mobile Web Development Essentials, Packt Publishing, Second Edition, 9781782167891. 3. Steven M. Schafer, "HTML, XHTML and CSS", Wiley India Edition, Fourth Edition, 978- 81-265-1635-3 4. Dr.HirenJoshi, Web Technology and Application Development, DreamTech, First,ISBN:978-93-5004-088-1 5. Ivan Bayross,"Web Enabled Commercial Application Development Using HTML, JavaScript, DHTML and PHP,BPB Publications,4th Edition,ISBN:978-8183330084. 6. Brain Fling, Mobile Design and Development, O'REILLY, First Edition, ISBN: 13:978-81- 8404-817- 7. Adam Bretz & Colin J Ihrig, Full Stack Javascript Development with MEAN, SPD, First Edition, ISBN:978-0992461256.

Home

Savitribai Phule Pune University, Pune
Third Year of Artificial Intelligence and Machine Learning (2020 Course)
318548-Elective-I-(A): : Robotics Laboratory

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Practical (PR) : 2 hrs/week	**01 Credit**	**OR : 25 Marks** **TW : 25 Marks**

Prerequisites: Basic Knowledge of Matlab, RoboMaster Software

Course Objectives :
- To understand DH parameter in Detail.
- To understand modeling of different grippers.

Course Outcomes :

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

CO1: Student must able to do the demonstration of Different robots

CO2: Student must know the different paths for robots

CO3: Student can able to do basic Program in Robotics.

Guidelines for Instructor's Manual

The faculty member should prepare the laboratory manual for all the experiments and it should be made available to students and laboratory instructor/Assistant.

Guidelines for Student's Lab Journal

1. Student should submit term work in the form of handwritten journal based on specified list of assignments.

2. Practical Examination will be based on the term work.

3. Candidate is expected to know the theory involved in the experiment.

4. The practical examination should be conducted if and only if the journal of the candidate is complete in all aspects.

Guidelines for Lab /TW Assessment

1. Examiners will assess the term work based on performance of students considering the parameters such as timely conduction of practical assignment, methodology adopted for implementation of practical assignment, timely submission of assignment in the form of handwritten write-up along with results of implemented assignment, attendance etc.

2. Examiners will judge the understanding of the practical performed in the examination by asking some questions related to the theory & implementation of the experiments he/she has carried out.

3. Appropriate knowledge of usage of software and hardware related to respective laboratory should be checked by the concerned faculty member

Guidelines for Laboratory Conduction

As a conscious effort and little contribution towards Green IT and environment awareness, attaching Printed papers of the program in journal may be avoided. There must be hand-written write-ups for every assignment in the journal. The DVD/CD containing students programs should be attached to the journal by every student and same to be maintained by department/lab In-charge is highly

encouraged. For reference one or two journals may be maintained with program prints at Laboratory.

| Guidelines for Practical Examination |
|---|
| 1. There will be 2 problem statements options and student will have to perform any one.
 2. All the problem statements carry equal weightage. |
| **List of Laboratory Assignments** |
| **Assignment 1:** Study of robotics System Design
 Assignment 2: Demonstration of Cartesian, Cylindrical and Spherical Robot
 Assignment 3: Demonstration of Articulated SCARA Robot.
 Assignment 4: To Verify Denavit- Hartenbertg parameter by using Robo Analyser Software.
 Assignment 5: Design and modeling and Analysis of Different grippers
 Assignment 6: Program for linear and nonlinear path
 Assignment 7: Virtual Modeling For Kinematic and dynamic verification of robot structure using any software
 Assignment 8: Study of Sensor Integration |
| **Reference Books:** |
| 1. K.S. Fu, R. C. Gonzalez, C.S.G. Lee, "Robotics-control, Sensing, Vision and Intelligence", Tata McGraw-Hill, ISBN 13:978-0-07-026510-3, ISBN 0-07-026510-0. |

Savitribai Phule Pune University, Pune **Third Year of Artificial Intelligence and Machine Learning (2020 Course)** **318548: Elective-I-(B) : Pattern Recognition Laboratory**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical (PR) : 02 hrs/week	**1 Credit**	**OR : 25 Marks** **TW : 25 Marks**

Prerequisites:

Course Objectives :

- Understand how to generate pattern features using various transforms based on data.
- Understand how to analyze pattern features using probability theory.
- Understand how to build classifiers using known probability distribution.
- Understand how to build classifiers using non parametric methods.
- Understand how to build linear classifiers using perception model.
- Understand how to build linear, nonlinear classifiers using SVM model.
- Understand how to build classifiers using syntactic model.
- Understand theory of unsupervised learning.

Course Outcomes :

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

CO1: Understand how to generate pattern features using various transforms based on data.

CO2: Understand how to analyze pattern features using probability theory.

CO3: Understand how to build classifiers using known probability distribution.

CO4: Understand how to build classifiers using non parametric methods.

CO5: Understand how to build linear classifiers using perception model.

CO6: Understand how to build linear, nonlinear classifiers using SVM model.

CO7: Understand how to build classifiers using syntactic model.

CO8: Understand theory of unsupervised learning

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), University syllabus, conduction & Assessment guidelines, topics under consideration, concept, objectives, outcomes, set of typical applications/assignments/ guidelines, and references.

Guidelines for Student's Lab 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 & 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 Lab /TW Assessment

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

Guidelines for Laboratory Conduction

Problem statements must be decided by the internal examiner in consultation with the 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. The questions asked will in no way be the deciding factor for passing the students. 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 Practical Examination

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

Required Background or Pre-requisite: Probability theory, Linear Algebra

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

Programming tools recommended: - Python

List of Laboratory Assignments

Group A

1. Generating features for two classes and analyzing them.
2. Building classifiers for two classes using Bay's rule

Group B

1. Building classifiers for multiple classes using Bay's rule.
2. Building classifiers for two classes using linear classifier.

Group C

1. Building classifiers for two classes using SVM
2. Implementation of clustering of patterns

Reference Books:

1. Pattern Recognition And machine learning by Christopher M. Bishop
2. Pattern Recognition Principal by R. C. Gonzalez
3. Probability and Statistics with Reliability, Queuing, and Computer Science Applications, Kishore Trivedi, John Wiley and Sons, New York, 2001.

4. Pattern Recognition, 4th Edition from Sergios Theodoridis, Konstantinos Koutroumbas. Elsevier ,ISBN-9781597492720, Printbook , Release Date: 2008.
5. Pattern Classification, 2nd Edition, Richard O. Duda, Peter E. Hart, David G. Stork. Wiley, ISBN: 978-0-471-05669

Virtual Laboratory :
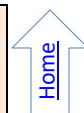
http://www.iitk.ac.in/idea/aidar.html

Savitribai Phule Pune University, Pune
Third Year of Artificial Intelligence and Machine Learning (2020 Course)
318548: Elective-I-(C) : Information Security Laboratory

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Practical (PR) : 02 hrs/week	1 Credit	OR : 25 Marks TW : 25 Marks

Prerequisites: ---

Course Objectives :

- To learns tools and techniques in the area of Information Security
- To formalize and implement constraints in search problems
- To understand the concepts of confidentiality, integrity, and availability of Information Security
- To understand the need of protection for information systems.

Course Outcomes :

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

CO1: Use tools and techniques in the area of Information Security
CO2: Use the cryptographic techniques for problem solving
CO3: Design and develop security solution
CO4: Protect and defend information systems.

Guidelines for Instructor's Manual
Lab Assignments: Following is a list of suggested laboratory assignments for reference. Laboratory Instructors may design a suitable set of assignments for their respective courses at their level. Beyond curriculum assignments, the mini-project is also 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. 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).

Guidelines for Student's Lab 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 journals may be avoided. Submission of journal/ term work in the form of softcopy is desirable and appreciated.

Guidelines for Lab /TW Assessment
Term work is continuous assessment that evaluates a student's progress throughout the semester. 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 an internal monthly Oral examination as part of continuous assessment.

Guidelines for Laboratory Conduction
Following is a list of suggested laboratory assignments for reference. Laboratory Instructors may design a suitable set of assignments for respective courses at their level. Beyond curriculum assignments and mini-project may be included as a part of laboratory work. 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. 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. 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 tutorials may be as per guidelines of authority.
Guidelines for Oral Examination
Both internal and external examiners should jointly conduct Oral examination. During assessment, the examiners should give the maximum weightage to the satisfactory answer of the problem statement in question. The supplementary and relevant questions may be asked at the time of evaluation to judge the student's understanding of the fundamentals, effective and efficient implementation.
List of Laboratory Assignments
Group A

1. Write a Java/C/C++/Python program that contains a string (char pointer) with a value \Hello World'. The program should AND or and XOR each character in this string with 127 and display the result.
2. Write a Java/C/C++/Python program to perform encryption and decryption using the method of Transposition technique.
3. Write a Java/C/C++/Python program to implement DES algorithm.
4. Write a Java/C/C++/Python program to implement AES Algorithm.
5. Write a Java/C/C++/Python program to implement RSA algorithm.
6. Implement the different Hellman Key Exchange mechanism using HTML and JavaScript. Consider the end user as one of the parties (Alice) and the JavaScript application as other party (bob).
7. Calculate the message digest of a text using the MD5 algorithm in JAVA.
8. **Mini Project**: Design and implement an application by using encryption techniques or other software security techniques algorithm that you have learnt in the above given assignments.

Reference Books:

1. William Stallings, Lawrie Brown, "Computer Security Principles and Practice", 3rd_Edition, Pearson
2. William Stallings, "Cryptography and Network Security Principals and Practice", Fifth edition, Pearson
3. Nina Godbole, Sunit Belapure, "Cyber Security", Wiley, ISBN: 978-81-265-2179-1

Virtual Laboratory :
http://vlabs.iitb.ac.in/vlabs-dev/

Savitribai Phule Pune University, Pune
Third Year of Artificial Intelligence and Machine Learning (2020 Course)
318548:Elective-I-(D):Business Intelligence Laboratory

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Practical (PR) : 02 hrs/week	**1 Credit**	**OR : 25 Marks** **TW : 25 Marks**

Prerequisites: DBMS

Course Objectives :
- To apply conceptual knowledge on various Business Analytics aspects.
- To explore various tools for Data Analysis and visualization
- To understand different practical techniques used by businesses for analytics
- To understand the mathematical and analytical models behind Business Intelligence

Course Outcomes :
1. On completion of the course, students will be able to–
2. CO1: Compare and analyze different analytical tools used by businesses
3. CO2: Understand the application of critical notion of KPI using real time case studies
4. CO3: Design and implement the analytical models using suitable tools
5. CO4: Create visualizations using suitable tools

Guidelines for Instructor's Manual

Lab Assignments: Following is a list of suggested laboratory assignments for reference. Laboratory Instructors may design a suitable set of assignments for their respective courses at their level. For each laboratory assignment, it is essential for students to draw/write/generate visualizations, mathematical model, Test data set and comparative/complexity analysis (as applicable).

Guidelines for Student's Lab Journal

Program codes / analysis with sample output of all performed assignments are to be submitted as softcopy. Use of Google Classroom / Drive /DVD or similar media containing student's 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 journals may be avoided. Submission of journal/ term work in the form of softcopy is desirable and appreciated.

Guidelines for Lab/TW Examination

Term work is continuous assessment that evaluates a student's progress throughout the semester. 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 an internal monthly practical examination as part of continuous assessment.

Guidelines for Laboratory Conduction
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List of Laboratory Assignments

Group A

1. Comparative Study of Open Source Data Analysis tools

2. Identify Key Performance Indicators (KPI) for any real time case study and present analysis for the same

Group B

1.Create, model and analyze Petri nets with a standards-compliant Petri net tool for Producer / Consumer OR Dining Philosophers problem

2.Perform a what-if-analysis on Book Store Scenario using Excel

3.Create a decision tree for predicting the loan eligibility process using Python

Group C

1.Create following visualizations using Excel

  a. Combo charts
  b. Band Chart
  c. Thermometer Chart
  d. Gantt Chart
  e. Waterfall Chart
  f. Sparklines
  g. PivotCharts

2. Create interactive visualizations using any open source tool. (Eg. KNIME, D3.js, Grafana, etc.)

3.Create a dashboard / report using Google Data Studio on YouTube Channel Data / Google Ads Data / Search Console Data

Reference Books:

1. Wilfried Grossmann & Stefanie Rinderle-Ma "Fundamentals of Business Intelligence", Springer, ISBN 978-3-662-46531-8 (eBook)
2. https://datastudio.google.com/

3. http://pipe2.sourceforge.net/
4. https://www.knime.com/

Savitribai Phule Pune University, Pune
Third Year of Artificial Intelligence and Machine Learning (2020 Course)
318549: Seminar / Mini Project

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Tutorial (TUT) : 01 hr/week	1 Credit	TW : 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 develop problem analysis skills.
- To develop critical thinking and engineering problem solving skills amongst the students.
- To explain the roles and responsibilities of IT engineers to the solution of engineering problems within the social, environmental and economic context.
- To learn the various processes involved in mini project

Course Outcomes :

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

CO1: Analyze a latest topic of professional interest.

CO2: Identify an engineering problem, analyze it and propose a work plan to solve it.

CO3: Communicate with professional technical presentation skills.

CO4: Design solution to real life problems and analyze its concerns through shared cognition.

CO5: Tackle technical challenges for solving real world problems with team efforts.

Guidelines for Seminar Selection and Presentation

1) Student shall identify the area or topics in Information Technology referring to recent trends and developments in consultation with industry (for their requirement) and institute guide.

2) Student must review sufficient literature (reference books, journal articles, conference papers, white papers, magazines, web resources etc.) in relevant area on their topic as decided.

3) Seminar topics should be based on recent trends and developments. Guide should approve the topic by thoughtfully observing different techniques, comparative analysis of the earlier algorithms used or specific tools used by various researchers in the domain.

4) Research articles could be referred from IEEE, ACM, Science direct, Springer, Elsevier, IETE,CSI or from freely available digital libraries like Digital Library of India (dli.ernet.in), National Science Digital Library, JRD Tata Memorial Library, citeseerx.ist.psu.edu, getcited.org, arizona.openrepository.com, Open J- Gate, Research Gate, worldwidescience.org etc.

5) Student shall present the study as individual seminars in 20 – 25 minutes in English which is followed by Question Answer session.

6) Guide should ensure that students are doing literature survey and review in proper manner.

7) Guide should give appropriate instructions for effective presentation.

8) Attendance of all other students in the class for presentation is mandatory.

Timeline is suggested to follow throughout the semester:

1) Week– 01: Discussion to understand what is technical paper, how to search, where to search?

2) Week– 02: Download technical papers (minimum four), getting approved from Guide and Prepare abstract summary of all papers downloaded.

3) Week– 03 & 04: Read and understand in detail the decided research papers about the problem statement, techniques used, experimental details and results with conclusion from identified papers.

4) Week– 05: Review of the studied papers by Guide / Panel.

5) Week – 06 & 07: Search / Find equivalent techniques (other than the one proposed in technical paper) so performance / complexities can be improved (by amortized analysis, not actual implementation).

6) Week – 08 & 09: Prepare presentation with outline as The topic, its significance, The research problem, Studied solutions (through research papers) with strengths and weaknesses of each solution, comparison of the solutions to research problem, future directions of work, probable problem statement of project, tentative plan of project work

7) Week – 10: Write Seminar report.

8) Week – 11: Deliver Presentation to Guide/ Panel.

9) Week –12: Verification of Seminar report and Submission

Guidelines for Seminar Report

1. Each student shall submit two copies of the seminar report in appropriate text editing tool/software as per prescribed format duly signed by the guide and Head of the department/Principal.

2. Broad contents of review report (20-25 pages) shall be
   a) 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, Year & University.
   b) Seminar Approval Sheet/Certificate.
   c) Abstract and Keywords.
   d) Acknowledgments.
   e) Table of Contents, List of Figures, List of Tables and Nomenclature.
   f) Chapters need to cover topic of discussion-
      i. Introduction with section including organization of the report,
      ii. Literature Survey
      iii. Motivation, purpose and scope and objective of seminar
      iv. Details of design/technology/Analytical and/or experimental work, if any/
      v. Discussions and Conclusions,
      vi. Bibliography/References (in IEEE Format),
      vii. Plagiarism Check report,

3. Students are expected to use open source tools for writing seminar report, citing the references and plagiarism detection.

Guidelines for TW Assessment

1. A panel of reviewers constituted by seminar coordinator (where guide is one of the members of the panel) will assess the seminar during the presentation.

2. Student's attendance for all seminars is advisable.

3. Rubric for evaluation of seminar activity:
   i. Relevance + depth of literature reviewed   - 05 Marks
   ii. Seminar report (Technical Content)   - 05 Marks
   iii. Seminar report (Language)   - 05 Marks
   iv. Presentation & Communication Skills   - 05 Marks
   v. Question and Answers   - 05 Marks

Guidelines for Mini Project

Mini-projects have their own importance. Mini-projects are neither a complete theory course nor a conventional practical. It is an activity of a group of students with intention to work on a "Specific Topic" of common interest which will give an experience of problem solving along- with group members, by using knowledge, facilities available and under the guidance of a faculty. Within a group, one may work on different components of work or all may work on each activities related work, depending on management of the work under the guidance of faculty (Guide) and nature of the work. Mini-projects help students in different ways like formation of groups, understanding group behavior, improving the communication skill, learning in depth with minimum time, interaction with guide and outside agencies, thinking about final year projects, etc. Normally, Mini-Projects are place at fifth or sixth semester in regular engineering course of eight semester duration. Though mini- project is new for third year (Fifth- sixth semester) engineering students, it is observed that students are always excited to work on "something new topic in Engineering" because their interest in learning in implementation of knowledge in actual fields rather than classes. This is due to about fifty percentage coverage of curriculum in earlier semester wherein most of the courses are informative in nature and concepts in engineering create more and more interest in learning. Therefore, Mini-projects are introduced at third year level so that students will get some experience by applying knowledge and concepts they learned and it is expected that they can perform well in their final year projects also.

Guidelines for Group Structure

Group structure should enable students to work in mentor–monitored groups. The students plan, manage and complete a task/project / activity which address the stated problem.
1. There should be a team of 3 to 6 students who will work cohesively.
2. A Mentor should be assigned to individual groups who will help them with learning and development process.

Guidelines for Selection of Project

1. The project scope/topic can be from any field/area, but selection related to IT technical aspect is desirous.
2. The project/problem done in first year engineering could be extended further, based on its potential and significance analysis.
3. Project/problem requiring solutions through conceptual model development and use of software tools should be preferred.
4. Different alternate approaches such as theoretical, practical, working model, demonstration or software analysis should be used in solving/implementing of project/problem.
5. The project/problem requiring multi-disciplinary approach to solve it should be preferred.
6. Problem may require in depth study of specific practical, scientific or technical domain.
7. Hands-on activities, organizational and field visits, interacting with research institutes and expert consultation should be included in the approach to make students aware of latest technologies.

Assessment

1.   The department should be committed to assess and evaluate both student performance and solution impact.

2.   Progress of project will be monitored regularly on weekly basis. Weekly review of the work is necessary. During process of monitoring and continuous assessment and evaluation the

individual and team performance is to be measured by mentor.

3.   Students must maintain an institutional culture of authentic collaboration, self-motivation, peer-learning and personal responsiveness. The institution/department should support students in this regard through guidance/orientation programs and the provision of appropriate resources and services. Supervisor/mentor and students must actively participate in assessment and evaluation processes. Group may demonstrate their knowledge and skills by developing a public product and/or report and/or presentation.

1. Individual assessment for each student (Understanding individual capacity, role and involvement in the project).

2. Group assessment (roles defined, distribution of work, intra-team communication and togetherness.

3. Documentation and presentation.

Evaluation and Continuous Assessment

It is recommended that the all activities are to be recorded in Project workbook, regular assessment of work to be done and proper documents are to be maintained at college end by both students as well as mentor.

The Project workbook will reflect accountability, punctuality, technical writing ability and work flow of the task undertaken. Continuous Assessment Sheet (CAS) is to be maintained by all mentors/department.

Recommended parameters for assessment, evaluation and weightage:

1. Idea Inception (5%)

2. Outcomes of Final project **(40%)** (Individual assessment and team assessment)

3. Documentation (Gathering requirements, design & modeling, implementation/execution, use of technology and final report, other documents **(25 %)**

4. Potential for the patent **(10%)**

5. Demonstration (Presentation, User Interface, Usability etc.) **(10%)**

6. Contest Participation/ publication **(5%)**

7. Awareness /Consideration of Environment/ Social /Ethics/ Safety measures/Legal aspects **(5%).**

Design the rubrics based on the above parameters for evaluation of student performance.

Faculty / Mentor is expected to perform following activities

Faculty/ Mentor is expected to perform following activities:

Revision of Project concepts

Skill assessment of students

Formation of diversified and balanced groups

Share information about patent, copyright and publications to make students aware about it

Discussion of sample case studies

Design of the rubrics for evaluation of student performance

Discussion of the rubrics with students

Weekly Assessment of the deliverables such as Presentation, Report, Concept map, logbook

Scaffolding of the students
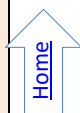
Summative and Formative assessment

## Suggested format for Mini-project

Title page	1 page
Certificate Page	1 Page

Acknowledgement	Half page
Content (Index)	1 or one & half page
Introduction	1 or 2 page
Problem statement and Objectives	1 page
Literature Review	5 to 10 pages depending on topic
Work Methodology as per nature of topic/work	10 to 20 pages
Summary of Results and discussion	2 to 4 pages
Conclusion and Future Scope	1 or half page
Letter of interaction with outside industry /institute/ individuals, paper details in journal or Participation certificate in conference, seminar , paper, Email correspondence,	1 to 4 pages
References	1 or 2 pages
Appendix if any	1 to 4 pages

SavitribaiPhule Pune University, Pune
Third Year of Artificial Intelligence and Machine Learning (2020 Course)
318550: Environmental Studies

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Tutorial(TUT): 1 hr /week	**01**	**Term Work : 25 Marks**

Prerequisite Courses, if any: ---

Companion Course, if any:---

Course Objectives:

Environmental studies are meant to bring balance between the environment and the living things through various objectives such as

- To create awareness among stakeholders
- To create mutual benefits to the environment
- To participate to conserve the environment through the individual level.
- To create a capacity building at the individual and at society level to minimize the negative impact of the human being.

Course Outcomes:

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

CO1: The understand nature of environment studies & Importance.

CO2: Design the Structure and function of ecosystem

CO3: The use of Natural Resources in real time environment

CO4: Undesirable changes occurring in the physical, chemical, and biological composition of natural environment consisting of air, water, and soil.

CO5: The commitment of an organization or government to the laws, regulations, and other policy mechanisms concerning environmental issues

CO6: Humans impact their environment through their habits, actions, and choices.

COURSE CONTENTS		
Unit I	**INTRODUCTION TO ENVIRONMENTAL STUDIES**	**(03 hrs)**

Multidisciplinary nature of environmental studies; Scope and importance; Concept of sustainability and sustainable development

Mapping of Course Outcomes for Unit I	CO1

Unit II	**ECOLOGY AND ECOSYSTEMS**	**(06 hrs)**

Concept of ecology and ecosystem, Structure and function of ecosystem; Energy flow in an ecosystem; food chains, food webs; Basic concept of population and community ecology; Characteristic features of the following: a) Forest ecosystem b) Grassland ecosystem c) Desert ecosystem d) Aquatic ecosystems (ponds, streams, lakes, wetlands, rivers, oceans, estuaries)

Mapping of Course Outcomes for Unit II	CO2

Unit III	NATURAL RESOURCES	(06 hrs)
Concept of Renewable and Non-renewable resources • Land resources and land use change; Land degradation, soil erosion and desertification. •Deforestation: Causes, consequences and remedial measures •Water: Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state)		
Mapping of Course Outcomes for Unit III	CO3	

Unit IV	ENVIRONMENTAL POLLUTION	(06 hrs)
Environmental pollution: concepts and types, Air, water, soil, noise and marine pollution- causes, effects and controls, Concept of hazards waste and human health risks, Solid waste management: Control measures of Municipal, biomedical and e-waste.		
Mapping of Course Outcomes for Unit IV	CO4	

Unit V	ENVIRONMENTAL POLICIES AND PRACTICES	(06 hrs)
Climate change, global warming, ozone layer depletion, acid rain and their impacts on human communities and agriculture, Environment Laws: Wildlife Protection Act; Forest Conservation Act. Water (Prevention and control of Pollution) Act; Air (Prevention & Control of Pollution) Act; Environment Protection Act; Biodiversity Act., International agreements: Montreal Protocol, Kyoto protocol and climate negotiations; Convention on Biological Diversity (CBD)., Protected area network, tribal populations and rights, and human wildlife conflicts in Indian context.		
Mapping of Course Outcomes for Unit V	CO5	

Unit VI	HUMAN COMMUNITIES AND THE ENVIRONMENT	(06 hrs)
Human population growth: Impacts on environment, human health and welfare. Case studies on Resettlement and rehabilitation, Environmental Disaster: Natural Disasters-floods, earthquake, cyclones, tsunami and landslides; Manmade Disaster- Bhopal and Chernobyl. Environmental movements: Silent valley, Big dam movements. Environmental ethics: Role of gender and cultures in environmental conservation. Environmental education and public awareness		
Mapping of Course Outcomes for Unit VI	CO6	

Text Books:
1.   sthana, D. K. (2006).Text Book of Environmental Studies. S. Chand Publishing.

Reference Books:
1. De, A.K., (2006).Environmental Chemistry, 6th Edition, New Age International, New Delhi. 2. Mahapatra, R., Jeevan, S.S., Das, S. (Eds) (2017). Environment Reader for Universities, Centre for Science and Environment, New Delhi. 3. Agarwal, K.C.(2001) Environmental Biology, Nidi Publ. Ltd. Bikaner.
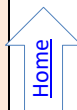
Savitribai Phule Pune University, Pune **Third Year of Artificial Intelligence and Machine Learning (2020 Course)** **Mandatory Audit Course 3** **318551 A: Road Safety**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
01hrs/week	**Non Credit**	**Audit Course**

Prerequisite Courses: ---

Course Objectives:
- To acquire knowledge and understanding of the road environment.
- To inculcate decision making and behavioral skills necessary to survive in the road Environment.
- To impart knowledge and understanding of the causes and consequences of accidents.
- To understand roles and responsibilities in ensuring road safety.

Course Outcomes:

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

CO1: Analyze traffic characteristics of roadways.

CO2: Understand the importance of planning for traffic safety and rehabilitation.

CO3: Acquire information and knowledge about people responsible for accidents and their duties.

CO4: Evaluate the causes of road accidents and take part in road safety audit.

CO5: Acquire a certificate in compulsory events based on the topic under study.

COURSE CONTENTS		
Unit I	**INTRODUCTION TO ROAD SAFETY**	**(02 hrs)**

Road traffic accidents scenario in India and in world, Road Safety and its importance. Traffic Rules and Driving Behavior, Characteristics of accidents, accidents vs. crash.

Mapping of Course Outcomes for Unit I	CO1

Unit II	**PLANNING FOR ROAD SAFETY**	**(02 hrs)**

Awareness about rules and regulations of traffic, Assisting Traffic control authorities, Multidisciplinary approach to planning for traffic safety and injury control, Vulnerable road Users: crashes related to pedestrian and bicyclists, their safety, provision for disabled.
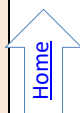
Mapping of Course Outcomes for Unit II	CO2

Unit III	**RESPONSIBILITY OF ROAD ACCIDENTS AND SAFETY MEASURES**	**(02 hrs)**

People responsible for accident prevention: Police, Politicians, Community members, Policy makers, Teachers, Parents, Infrastructure authorities, Drivers and Official road safety body. Reasons of students/ children have accidents.
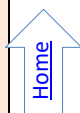
4 E's of Accidents Prevention: 1. Engineering – by altering the environment 2. Enforcement - by imposing laws 3. Encouragement - by the use of publicity campaigns 4. Education - by gaining and using knowledge.

Mapping of Course Outcomes for Unit III	CO3	
Unit IV	**ROAD SAFETY EDUCATION**	**(2 hrs)**

Introduction to Road Safety Education. 5 P's of Road safety education: Pre-school road safety education, Practical rather than theory education, Principles of own development as regards to road safety education, Presentations on road safety education, Place for road safety education in syllabus

Mapping of Course Outcomes for Unit IV	CO4	
Unit V	**ROAD SAFETY EVENTS**	**(2 hrs)**

Discussions on efforts done by Government on Road Safety. Celebration of Road Safety week or Workshop on Road Safety week/ Organization of seminar on Road Safety. This is to be entirely organized by students under the mentorship of concerned Head of the Department.

Mapping of Course Outcomes for Unit V	CO5

Text Books:

1. Kadiyali L.R., Traffic Engineering & Transport Planning, Khanna Publishers, 2003
2. CROWN AGENTS Ref: TEA/A369, 1995. (Unpublished contractors report for Ministry of Transport and Communications, Ghana
3. TRRL OVERSEAS UNIT, 1991. Towards safer roads in developing countries: a guide for planners and engineers. Crow Thorne: Transport and Road Research Laboratory.

Reference Books:

1. Indian Roads Congress, Highway Safety Code, IRC: SP-44:1996
2. Indian Roads Congress, Road Safety Audit Manual, IRC:SP-88-2010

Savitribai Phule Pune University, Pune
Third Year of Artificial Intelligence and Machine Learning (2020 Course)
Mandatory Audit Course 3
318551 B: Engineering Economics

Teaching Scheme:	Credit Scheme:	Examination Scheme:
01hrs/week	**Non Credit**	**Audit Course**

Prerequisite Courses, if any: ---

Course Objectives:

1.To enable students to understand the fundamental economic concepts applicable to engineering

2. To learn the techniques of incorporating inflation factor in economic decision making.

Course Outcomes:

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

CO1: Understand rational decision making and impact on economics

CO2: Perform calculations for interest rates and rates of return.

CO3: Calculate the present, annual and future worth of cash flows

CO4: Understand Fundamental approach and terminology of replacement analysis

COURSE CONTENTS		
Unit I	**FOUNDATION OF ENGINEERING ECONOMY**	**(3 hrs)**

Overview of Engineering Economy: Definition and Scope of Engineering Economics, Professional Ethics and Economic Decisions, steps of decision making

Elementary Economic Analysis: Material selection for product Design selection for a product, Process planning.

Mapping of Course Outcomes for Unit I	CO1	
Unit II	**VALUE ENGINEERING**	**(3hrs)**

Value engineering- Introduction, Time value of money.

Interest formulae and their applications – Single payment compound amount factor, Single payment present worth factor, Equal payment series sinking fund factor, Equal payment series payment Present worth factor- equal payment series capital recovery factor - Uniform gradient series annual equivalent factor, Effective interest rate

Mapping of Course Outcomes for Unit II	CO1,CO2	
Unit III	**CASH FLOW ANALYSIS**	**(3 hrs)**

Methods of comparison of alternatives – present worth method (Revenue dominated cash flow diagram), Future worth method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), Annual equivalent method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), rate of return method

Mapping of Course Outcomes for Unit III	CO3	
Unit IV	**REPLACEMENT AND MAINTENANCE ANALYSIS**	**(3 hrs)**
Replacement and Maintenance analysis – Types of maintenance, types of replacement problem, determination of economic life of an asset		
Mapping of Course Outcomes for Unit IV	CO2,CO4	
Text Books:		
1. Panneer Selvam, R, "Engineering Economics", Prentice Hall of India Ltd, New Delhi,2001.		
Reference Books:		
1. Chan S.Park, "Contemporary Engineering Economics", Prentice Hall of India, 2011. 2. Donald.G. Newman, Jerome.P.Lavelle, "Engineering Economics and analysis" Engg. Press, Texas, 2010. 3. Degarmo, E.P., Sullivan, W.G and Canada, J.R, "Engineering Economy", Macmillan, New York, 2011. 4. Zahid A khan: Engineering Economy, "Engineering Economy", Dorling Kindersley, 2012		

Savitribai Phule Pune University, Pune
Third Year of Artificial Intelligence and Machine Learning (2020 Course)
Mandatory Audit Course 3
318551 C: Language Study-Module III

Teaching Scheme:	Credit Scheme:	Examination Scheme:
01hrs/week	Non Credit	Audit Course

Prerequisite Courses, if any:
1. Students must have already studied can read/write Hiragana and Katakana script
2. Students must have studied Japanese for beginners that includes the syllabus of Audit course Module 1 and 2

Course Objectives:
To familiarize students with-
- Japan Market needs: To meet the needs of ever growing industry with respect to the Japanese language support.
- Japanese Culture and Mindset: To get introduced to Japanese society and culture through language.
- Career opportunities: To know more about Higher studies, Career opportunities in Japan / Japanese companies across the world.
- Soft skills and self-development: To learn the manners, business culture and develop the confidence by gaining the knowledge of global perspective and cross-cultural studies.

Course Outcomes:
On completion of the course, students will be able to–
    CO1: Ability of basic communication.
    CO2: Knowledge of Japanese script (reading, writing and listening skills).
    CO3: Knowledge about Japanese culture, life style, manners and etiquettes.
    CO4: Develop interest to pursue professional Japanese Language course.

COURSE CONTENTS

Unit I	JAPANESE-BEGINNERS LEVEL	(03 hrs)

Greeting, Self-introduction, Nationality, Languages, Hiragana, Katakana rules, History of Kanji, Numbers, Days and Dates, Time, Age, Mobile number, Places, Relatives, Colors, Things, Vehicles. Introduction to grammar of basic particles, verbs and adjectives, Culture/Others: Business card exchange, Seasons and festivals in Japan, Kanjis: 1 to 10, Listening practice, Vocabulary and conversation practice.
Reference:
a. Revision of beginner level studied in Module1-2
b. Nihongo Challenge Kanji - Lesson 1

Mapping of Course Outcomes for Unit I	CO1

Unit II	JAPANESE SCRIPT	(03 hrs)

Introduction to Demonstrative pronouns (ko-so-a-do),Asking/requesting for something, Making sentences using various question words, Stating/asking age, nationality, profession ,Culture/Others: Information about Japanese standardized test (JLPT, NAT etc.),Kanjis:11 to 20,Listening practice Vocabulary and conversation practice.
Reference:
a. Minna no Nihongo I: Lesson 1 and 2 (Text book + Audio and Video)
b. Nihongo Challenge Kanji - Lesson 2

Mapping of Course Outcomes for Unit II	CO2

Unit III	BASIC JAPANESE GRAMMAR	(03 hrs)

Conversation at the shop, asking price, location, Telling time and scheduling tasks, Introduction to Verb groups (root, present, past, negative), Culture/Others: Conversation and Behavior at the shop, How to buy train tickets, Train manners, Introduction to social issues and Japanese society,Kanjis:21to 30,Listening practice Vocabulary and conversation practice.
Reference:
a. Minna no Nihongo I : Lesson 3 and 4 (Text book + Audio and Video)
b. Nihongo Challenge Kanji - Lesson 3

Mapping of Course Outcomes for Unit III	CO3

Unit IV	JAPANESE FOR DAILY COMMUNICATION	(03 hrs)

Directions and heading towards (use of particle de, he and relevant vocabulary) , Actions (use of particle wo and relevant vocabulary),Types of adjectives (root, negative, past, past negative),Culture/Others: Party, gifts related conversation, Gifting culture in Japan, Introduction to Japanese economy and market needs ,Kanjis:31 to 40,Listening practice, Vocabulary and conversation practice.
Reference:
a. Minna no Nihongo I : Lesson 5 and 6 (Text book + Audio and Video)
b. Nihongo Challenge Kanji - Lesson 4

Mapping of Course Outcomes for Unit IV	CO4

Text Books:
1. Minna no Nihongo I–MainText book with audio and video files(Books by Goyal Publishers – Available in shops / Online)
2. Minna no Nihongo - Translation and grammatical notes for self-study(Books by Goyal Publishers Available in shops / Online)
3. Nihongo Challenge – Kanji(Available with Japanese Language schools/teachers)

Reference Books:
1. Nihongo Shoho: For better understanding and practice of Basic Japanese Grammar 2. Marugoto : For scenario based Japanese conversation practice
E -Books / E- Learning References :

1. nihongo ichiban
   a. https://nihongoichiban.com/home/jlpt-n5-study-material/
2. jlpt sensei
   a. https://jlptsensei.com/how-to-pass-jlpt-n5-study-guide/
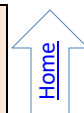
Savitribai Phule Pune University, Pune		
Third Year of Artificial Intelligence and Machine Learning (2020 Course)		
Mandatory Audit Course 3		
318551 D: MOOC- Learn New skills		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
01hrs/week	**Non Credit**	**Audit Course**

Prerequisites: Basic Knowledge of computer and Programming Skills

Course Objectives :
1. To promote interactive user forums to support community interactions among students, professors, and experts.
2. To promote learn additional skills anytime and anywhere
3. To enhance teaching and learning on campus and online

Course Outcomes :

On completion of the course, learner will acquire additional knowledge of computer and programming skills.

About the Course

MOOCs (Massive Open Online Courses) provide affordable and flexible way to learn new skills, pursue lifelong interests and deliver quality educational experiences at scale. Whether you're interested in learning for yourself, advancing your career or leveraging online courses to educate your workforce, SWYAM, NPTEL, edx or similar ones can help. World's largest SWAYAM MOOCs, a new paradigm of education for anyone, anywhere, anytime, as per your convenience, aimed to provide digital education free of cost and to facilitate hosting of all the interactive courses prepared by the best more than 1000 specially chosen faculty and teachers in the country. SWAYAM MOOCs enhances active learning for improving lifelong learning skills by providing easy access to global resources. SWAYAM is a programme initiated by Government of India and designed to achieve the three cardinal principles of Education Policy viz., access, equity and quality. The objective of this effort is to take the best teaching learning resources to all, including the most disadvantaged. SWAYAM seeks to bridge the digital divide for students who have hitherto remained untouched by the digital revolution and have not been able to join the mainstream of the knowledge economy. In order to ensure that best quality content is produced and delivered, nine National Coordinators have been appointed. Out of these nine National Coordinators, NPTEL (National Programme on Technology Enhanced Learning) is for Engineering

Guidelines for Instructor's

- Instructor/mentor is requested to promote students to opt for courses with proper mentoring.
- Instructor/Mentor who teach the course or in relevant discipline can be a mentor .Should enroll to the course
- Instructor/Mentor can only choose up to 2 courses.
- One mentor for every 50 to 60 students.
- Instructor/Mentors can see the assignment scores of mentees
- Instructor/Mentors can help with explaining gaps in taught concepts.
- Instructor/Mentors can give more practice assignments
- The departments will take care of providing necessary infrastructural facilities and other facilities for the learners.
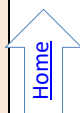
Guidelines for Student's
- Students have to select the mentor on the portal   - NPTEL is offering the online courses with a timeline of 4, 8 or 12-weeks through an online portal.   - SPPU Student has to take 8 weeks course for 2 credits.   - Each week, you need to watch 3 to 6 video lectures (of length 20 to 30 minutes) and attempt one online Assignment quiz at your convenient time and submit with in a deadline. Also submit the same assignments to the mentor as a part of journal. This is **mandatory** for all the students who opted mandatory audit course 3 as MOOC-Learn new skills.   - The enrolment to and learning from these courses involves no cost watch video lectures and attempt. Assignment online quizzes.   - After 2-3 weeks of starting of the course, an option of Registration for Final Exam with the fees of Rs. 1000/1100 will be given. If you're confident enough, you can proceed to the Exam Registration.This is **optional** for students.   - If the student wish to opt an option of registration for final exam then E-certificate from organizing IIT/IISc will be given to the successful candidates of the Final score=25% assignment score (online) + 75% exam (offline) score. To be eligible for a certificate, the learner should have scored >=40% final score.   - E-verifiable certificates are made available on nptel.ac.in   - NPTEL conduct final (proctored) exam at different exam centers all over India.   - After completion of the exam, student must submit the E-certificate to the college/department.
References
1. https://swayam.gov.in/   2. https://onlinecourses.nptel.ac.in/   3. https://www.edx.org

SEMESTER – VI

Savitribai Phule Pune University, Pune
Third Year of Artificial Intelligence and Machine Learning (2020 Course)
318552: Machine Intelligence for Data Science

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory (TH) : 3 hrs/week	**03 Credits**	**Mid_Semester : 30 Marks**
		End_Semester : 70 Marks

Prerequisite Courses: 218553:Fundamentals of Artificial Intelligence and Machine Learning

Companion Course: 318556:Software Lab II (Machine Intelligence for Data Science & ANN)

Course Objectives:
- To learn data collection and preprocessing techniques for data science
- To understand basis of statistics and mathematics for Machine Learning
- To understand and learn regression models, interpret estimates and diagnostic statistics
- To understand and learn different classification models and its algorithms
- To learn decision tree and ensembles methods
- To understand and learn clustering methods

Course Outcomes:

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

CO1: Apply data preprocessing methods on open access data and generate quality data for analysis

CO2: Apply appropriate statistical measure for machine learning applications.

CO3: Apply regression techniques to machine learning problems.

CO4: Apply and build classification models using SVM.

CO5: Apply decision tree and ensembles methods to solve real time applications.

CO6: Apply and build clustering models using clustering methods and its corresponding algorithms.

COURSE CONTENTS

Unit I	INTRODUCTION TO DATA SCIENCE	(06 hrs)

Defining data science and big data, Recognizing the different types of data, Gaining insight into the data science process, Data Science Process: Overview, Different steps, Machine Learning Definition and Relation with Data Science.

Mapping of Course Outcomes for Unit I	CO1

Unit II	STATISTICS AND PROBABILITY BASICS FOR DATA ANALYSIS	(06 hrs)

Statistics: Describing a Single Set of Data, Correlation, Simpson's Paradox, Some Other Correlational **Caveats, Correlation and Causation**
Probability : Dependence and Independence, Conditional Probability, Bayes's Theorem, Random Variables, Continuous Distributions, The Normal Distribution, The Central Limit Theorem

Mapping of Course Outcomes for Unit II	CO2

Unit III	REGRESSION MODELS	(06 hrs)
Overview of statistical linear models, residuals, regression inference, Generalized linear models, logistic regression, Interpretation of odds and odds ratios, Maximum likelihood estimation in logistic regression, Poisson regression, Examples, Interpreting logistic regression, Visualizing fitting logistic regression curves.		
Exemplar/Case Studies	Remote sensing and GIS-based landslide hazard analysis and cross-validation using multivariate logistic regression model	
Mapping of Course Outcomes for Unit III	CO3	
Unit IV	CLASSIFICATION METHODS	(06 hrs)
Support Vector Machine classification algorithm, hyper plane, optimal separating hyper planes , kernel functions, kernel selection, applications, Introduction to ensemble and its techniques, Bagging and Bootstrap ensemble methods, Introduction to random forest, growing of random forest, random feature selection.		
Exemplar/Case Studies	Face recognition using SVM Or Product review case study in area of sentimental analysis using SVM and random forest classifiers	
Mapping of Course Outcomes for Unit IV	CO4	
Unit V	DECISION TREES & ENSEMBLES METHODS	(06 hrs)
Decision Trees: What Is a Decision Tree? Entropy, The Entropy of a Partition, Creating a Decision Tree, Random Forests, **Algorithms:** ID4, C4.5, CART. **Ensembles Methods:** Bagging & boosting and its impact on bias and variance, C5.0 boosting, Random forest, Gradient Boosting Machines and XGBoost		
Mapping of Course Outcomes for Unit V	CO5	
Unit VI	CLUSTERING METHODS	(06 hrs)
Overview of clustering and unsupervised learning, Introduction to clustering methods: Partitioning methods, Density-Based Spatial Clustering, Hierarchical clustering methods: Agglomerative Hierarchical clustering technique, Roles of dendrograms and Choosing number clusters in Hierarchical clustering, Divisive clustering techniques.		
Exemplar/Case Studies	Case study on DNA sequencing and hierarchical clustering to find the phylogenetic tree of animal evolution	
Mapping of Course Outcomes for Unit VI	CO6	
Text Books:		
1. Tom M. Mitchell, "Machine Learning", India Edition 2013, McGraw Hill Education. 2. S.P. Gupta, "Statistical Methods", Sultan Chand and Sons, New Delhi, 2009, 3. Douglas Montgomery, Elizabeth A. Peck, and G. Geoffrey Vining, "Introduction to Linear Regression Analysis", 5th edition, Wiley publication. 4. Ethem Alpaydin: Introduction to Machine Learning, PHI 2nd Edition-2013		

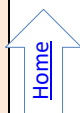| Reference Books: |
|---|
| 1. Peter Harrington, Machine Learning In Action, DreamTech Press 2.ISBN: 9781617290183 |
| 2. Alpaydin, Ethem. Machine learning: the new AI. MIT press, 2016, ISBN: 9780262529518 |
| 3. Stephen Marsland, Machine Learning An Algorithmic Perspective, CRC Press, ISBN: : 978-1-4665-8333-7 |
| 4. Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking, Vovost Foster, Fawcett Tom |
| **E Books / E Learning References :** |
| **E Books:** |
| 1. Charu C. Aggarwal, Chandan K. Reddy, "Data Clustering Algorithms and Applications", CRC Press |
| **MOOCs Courses link:** |
| 1. https://nptel.ac.in/courses/106/106/106106139/ |
| 2. https://nptel.ac.in/courses/106/105/106105152/ |

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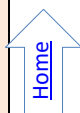<tr><td colspan="3" align="center">**Savitribai Phule Pune University, Pune**
Third Year of Artificial Intelligence and Machine Learning (2020 Course)
318553: Data Mining & Warehousing</td></tr>
<tr><td>**Teaching Scheme:**</td><td>**Credit Scheme:**</td><td>**Examination Scheme:**</td></tr>
<tr><td>**Theory (TH) : 3 hrs/week**</td><td>**03 Credits**</td><td>**Mid_Semester : 30 Marks**
End_Semester : 70 Marks</td></tr>
<tr><td colspan="3">**Prerequisite Courses:** Database Management Systems</td></tr>
<tr><td colspan="3">**Course Objectives:**

- Learn how to build a data warehouse and query it (using open source tools like Pentaho Data Integration Tool, Pentaho Business Analytics).
- Learn to perform data mining tasks using a data mining toolkit (such as open source WEKA).
- Understand the data sets and data preprocessing.
- Demonstrate the working of algorithms for data mining tasks such association rule mining, classification, clustering and regression.
- Exercise the data mining techniques with varied input values for different parameters.
- To obtain Practical Experience Working with all real data sets.
- Emphasize hands-on experience working with all real data sets.</td></tr>
<tr><td colspan="3">**Course Outcomes:**

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

CO1: Ability to understand the various kinds of tools.

CO2: Apply frequent pattern and association rule mining techniques for data analysis

CO3: Apply appropriate classification and clustering techniques for data analysis

CO4: Apply frequent pattern and association rule mining techniques for data analysis & Study Warehouse with design and Components.

CO5: Apply suitable pre-processing and visualization techniques for data analysis

CO6: Design a Data warehouse system and perform business analysis with OLAP tools.</td></tr>
<tr><td colspan="3" align="center">**COURSE CONTENTS**</td></tr>
<tr><td align="center">**Unit I**</td><td align="center">**INTRODUCTION TO DATA MINING**</td><td align="center">**(07 hrs)**</td></tr>
<tr><td colspan="3">Definition of data mining- Data Mining Techniques – Issues – applications- Data Objects and attribute types-knowledge discovery Process, Data Mining Functionalities, Classification of Data Mining Systems , Statistical description of data, Data Preprocessing – Cleaning, Integration, Reduction, Transformation and discretization, Data Visualization, Data similarity and dissimilarity measures. Data Mining Task Primitives, Mining Frequent Patterns, Associations, Market Basket Analysis, Apriori Algorithm, Association rules from frequent item set, Text Mining and Web Mining.</td></tr>
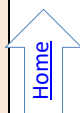<tr><td>**Mapping of Course Outcomes for Unit I**</td><td colspan="2">CO1</td></tr>
</table>

Unit II	CLASSIFICATION AND PREDICTION	(07 hrs)

Introduction, Classification by Decision Tree Induction, Attribute selection measures, Bayesian Classification , Bayes Theorem ,Naïve Bayesian Classification , Rule-Based Classification, If then rules for classification, Rule Extraction from decision tree, Classification by Back propagation, Support Vector Machines. Mining

Data Mining-frequent Pattern Analysis: Frequent Patterns, Associations and Correlations – Mining Methods- Pattern Evaluation Method – Pattern Mining in Multilevel, Multi-Dimensional Space – Constraint Based Frequent Pattern Mining, Classification using Frequent Patterns.

Case Study	WEKA Tool
Mapping of Course Outcomes for Unit II	CO2

Unit III	CLUSTER ANALYSIS AND BUSINESS INTELLIGENCE	(07 hrs)

Introduction to Cluster Analysis-Types, Categorization of Major Clustering Methods, Clustering techniques: - Partitioning (k-means, k-means++, Mini-Batch k-means, k-medoids), Hierarchical (Agglomerative and Divisive), Density based (DBSCAN), Grid Based Methods, Outlier analysis-outlier detection methods,

Business Intelligence: Introduction to Data, Information, and Knowledge, Design and implementation aspect of OLTP, Introduction to Business Intelligence and Business Models, BI Definitions & Concepts, Business Applications of BI, Role of DW in BI, BI system components, Components of Data Warehouse Architectures.

Case Study	Learn Different ETL Tools
Mapping of Course Outcomes for Unit III	CO3,CO4

Unit IV	INTRODUCTION TO DATA WAREHOUSING	(07 hrs)

Introduction to Decision Support System, Need for data warehousing, Operational & informational data, Data Warehouse definition and characteristics, Data Warehouse Architecture.

Warehouse Design: The Process of Data Warehouse Design, A Three-Tier Data Warehouse Architecture, Conceptual modelling of data warehouse, Differences between operational database and data warehouse, Data warehouse implementation, Data marts, Components of data warehouse, Need for data warehousing ,Trends in data warehousing

Mapping of Course Outcomes for Unit IV	CO4

Unit V	DATA WAREHOUSE COMPONENTS	(07 hrs)

Architectural components: ETL Process, Data Preprocessing: Why Preprocess Data? Data Life Cycle, Data Cleaning Techniques, Data Integration and Transformation, Data Reduction strategies overview, Discretization and Concept Hierarchy Generation for numerical data techniques binning, histogram analysis, For categorical data techniques concept hierarchies, Significant role of metadata, Data warehouse applications and usage.

Case Study	Graph Mining and Social Network Analysis

Mapping of Course Outcomes for Unit V	CO5	
Unit VI	**OLAP IN THE DATA WAREHOUSE**	**(07 hrs)**
A Multidimensional Data Model, Schemas for Multidimensional Databases: Stars, Snowflakes, and Fact Constellations Measures, Concept Hierarchies, OLAP Operations in the Multidimensional Data Model, Need for OLAP, OLAP tools, Types-ROLAP, MOLAP, HOLAP.		
Case Study	**Mining Spatial, Multimedia, Text and Web Data**	
Mapping of Course Outcomes for Unit VI	CO6	

Text Books:
1. Data Mining Concepts and Techniques by Han, Kamber, Morgan Kaufmann , MK publication.
2. Data Mining: Concepts and Techniques by Margaret Dunham, Morgan Kaufmann Publication.
3. Data Warehousing Fundamentals by Paul Punnian, John Wiley Publication.
4. Data Warehousing, Data Mining and OLAP by Alex Berson, S.J. Smith, Tata McGraw Hill
Reference Books:
1. The Data Warehouse Lifecycle Toolkit by Ralph Kimball, John Wiley
2. Business Intelligence: A Managerial Approach (2nd Ed,) Turba. N, Sharda, Delen, King.Wiley Publication

Savitribai Phule Pune University, Pune Third Year of Artificial Intelligence and Machine Learning (2020 Course) **318554: Artificial Neural Networks**		
Teaching Scheme	**Credit Scheme**	**Examination Scheme**
Theory (TH) : 3 hrs/week	**03Credits**	**Mid_Semester : 30 Marks** **End_Semester :70 Marks**

Prerequisite Courses: **Linear Algebra, Matrix Algebra, Probability**

Companion Course: -----

Course Objectives:

- To understand Learning tasks, Patterns, Pattern Recognition Problems and Learning Paradigms.
- To understand Learning types in Neural Networks
- To study neural network architectures and their applications

Course Outcomes:

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

CO1: Recognize Learning Tasks and Learning Problems

CO2: Differentiate between Learning in humane and Learning in Artificial Neural Networks.

CO3: Understand Predictive learning with Feed Forward Neural Networks and Limitations

CO4: Analyze Neural network architectures for solving Optimization Problems

CO5: Investigate neural network architecture for descriptive tasks

CO6: Understand learning type in Deep Neural Networks and their Applications

COURSE CONTENTS		
Unit I	**BASICS OF NEURAL NETWORKS**	**(06 hrs)**

Review of Transistor as a switch, Logic gates and Truth Tables. Characteristic of Neural Networks, Historical Development of Neural Networks, Biological Neuron and their artificial Model, McCulloch Pitts Neuron Model, Thresholding Logic functions, Neural Network Learning rules, Perceptron Learning Algorithm, Perceptrons Model, Simulation of logic gates, Limitations of Pereceptron Learning.

Mapping of Course Outcomes for Unit I	CO1

Unit II	**LEARNING TASKS**	**(06hrs)**

Trends in Computing, Data and Patterns, Pattern Recognition Tasks, Pattern Recognition Problem , Methods for Pattern Recognition Tasks. Learning Tasks in humane: Descriptive Tasks- Clustering and Associations, Predictive Tasks- Regression and Classification. Learning Paradigms- Supervised, Unsupervised and Reinforcement Learning.

Mapping of Course Outcomes for Unit II	CO2

Unit III	FEED FORWARD NEURAL NETWORKS	(06hrs)

Multilayer Perceptrons (MLPs), Architectures of Neural Networks, Feed Forward Neural Networks and Representation Power of MLPs, Learning in Feed Forward Neural Networks- Descriminant Functions- Sigmoid Neurons, Error Back Propagation Algorithm, Learning Factors and Performance issues. Gradient Descent(GD), Momentum Based GD, Stochastic GD. Applications of FF Neural Networks.

Mapping of Course Outcomes for Unit III	CO3

Unit IV	FEEDBACK NEURAL NETWORKS	(06 hrs)

Architecture of FeedBack Neural Netwoks, Auto associative FF Networks, Pattern Storage Networks, Stochastic Networks and Simulated Annealing, Hope field Networks and Boltzman Machines. Recurrent Neural Networks and Applications.

Mapping of Course Outcomes for Unit IV	CO4

Unit V	COMPETITIVE LEARNING NETWORKS	(07hrs)

Components of competitive Learning, Self-Organizing Maps (SOM), Semantic Networks, Pattern Clustering Networks, Feature Mapping Networks, Applications of SOM. Adaptive Resonance Theory (ART) and Networks, Applications of ART.

Mapping of Course Outcomes for Unit V	CO5

Unit VI	DEEP LEARNING NEURAL NETWORKS	(06hrs)

Architectures of Deep Learning Networks, Input Layer, Hidden Layers, Output Layer, Deep Convolutional Neural Networks(CNN), Deep Recurrent Neural Networks (RNN), LSTM Networks, Difference between Traditional Machine Learning and Learning in Deep Neural Networks, Applications of Deep Learning Networks.

Mapping of Course Outcomes for Unit VI	CO6

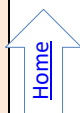| Text Books: |
|---|
| 1. Artificial Neural Networks by B YegnaNarayana, PHI. |
| 2. Introduction to Artificial Neural Systems, J M Zurada, West Publishing Company, |
| |
| Reference Books: |
| 1. Neural Networks, Fuzzy logic and Genetic Algorithms , S. Raj sekaran, VijayalakshmiPari
2. Artificial Neural Networks : An Introduction –Kevin.L.Priddy,PaulE.Keller |

	Savitribai Phule Pune University, Pune **Third Year of Artificial Intelligence and Machine Learning (2020 Course)** **318555: Elective II (A) : Industrial Internet of Things**	
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory (TH) : 3 hrs/week	**03 Credits**	**Mid_Semester : 30 Marks** **End_Semester :70 Marks**

Prerequisite Courses, if any:

Companion Course, if any:

Course Objectives:

- Study of Building blocks of IOT and its various components
- Study of protocols in IOT
- Analyze the security issues in IOT
- Select proper IOT technology for application.
- Design simple IOT based application

Course Outcomes:

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

CO1: Describe Industrial Internet of Things and Cyber Physical manufacturing

CO2: Demonstrate Cyber Physical and Cyber Manufacturing systems

CO3: Describe Architectural design patterns for industrial Internet of Things

CO4: Analyze AI and data Analytics for Industrial Internet of Things

CO5: Evaluation of Workforce and Human Machine Interaction and Application of Industrial Internet of Things

CO6: Ability to implement real field problem by gained knowledge of Industrial applications with
IoT capability.

COURSE CONTENTS		
Unit I	**UNDERSTANDING INDUSTRIAL INTERNET OF THINGS (IIOT)**	**(06 hrs)**

Industrial Internet of Things and Cyber Manufacturing Systems, Application map for Industrial Cyber Physical Systems, Cyber Physical Electronics production.

Mapping of Course Outcomes for Unit I	CO1

Unit II	**MODELING OF CPS AND CMS**	**(07 hrs)**

Modeling of Cyber Physical Engineering and manufacturing, Model based engineering of supervisory controllers for cyber physical systems, formal verification of system, components, Evaluation model for assessments of cyber physical production systems.

Mapping of Course Outcomes for Unit II	CO2

Unit III	ARCHITECTURAL DESIGN PATTERNS FOR CMS AND IIOT	(07 hrs)
CPS-based manufacturing and Industries, Integration of Knowledge base data base and machine vision, Interoperability in Smart Automation, Enhancing Resiliency in Production Facilities through CPS. Communication and Networking of IIoT.		
Mapping of Course Outcomes for Unit III	CO3	
Unit IV	ARTIFICIAL INTELLIGENCE AND DATA ANALYTICS FOR MANUFACTURING	(08 hrs)
Application of CPS in Machine tools, Digital production, Cyber Physical system Intelligence, Introduction to big data and machine learning and condition Monitoring		
Mapping of Course Outcomes for Unit IV	CO4	
Unit V	EVALUATION OF WORKFORCE AND HUMAN MACHINE INTERACTION	(06 hrs)
Worker and CPS, Strategies to support user intervention. Introduction to Advance manufacturing and Innovation Ecosystems.		
Mapping of Course Outcomes for Unit V	CO5	
Unit VI	APPLICATION OF IIOT	(06 hrs)
Smart Metering, e-Health Body Area Networks, City Automation, Automotive Applications, Home Automation, Smart Cards, Plant Automation, Real life examples of IIOT in Manufacturing Sector.		
Mapping of Course Outcomes for Unit VI	CO6	
Text Books:		

1.
    abina Jeschke, Christian Brecher Houbing Song , Danda B. Rawat Editors Industrial Internet of Things Cyber Manufacturing Systems
2.
    akima Chaouchi, " The Internet of Things Connecting Objects to the Web" ISBN : 978-1- 84821- 140-7, Willy Publications Olivier Hersent, David Boswarthick, Omar Elloumi,
3.
    he Internet of Things: Key Applications and Protocols, ISBN: 978-1-119-99435-0, 2nd Edition, Willy Publications
4.
    nside the Internet of Things (IoT), Deloitte University Press

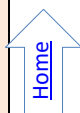| Reference Books: |
|---|
| 1. Internet of Things- From Research and Innovation to Market Deployment; By Ovidiu & Peter; River Publishers Series |
| 2. Five thoughts from the Father of the Internet of Things; by Phil Wainewright - Kevin Ashton |
| 3. How Protocol Conversion Addresses IIoT Challenges: White Paper By RedLion. |
| 4. Dr. Guillaume Girardin , Antoine Bonnabel, Dr. Eric Mounier, 'Technologies Sensors for the Internet of Things Businesses & Market Trends 2014 -2024',Yole Development Copyrights ,2014 |
| |
| **E Books / E Learning References :** |
| 1. https://nptel.ac.in/courses/106105195 |
| |

Savitribai Phule Pune University, Pune
Third Year of Artificial Intelligence and Machine Learning (2020 Course)
318555: Elective II (B) : Brain Computer Interface

Home

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory (TH) : 3 hrs/week	**03 Credits**	**Mid_Semester : 30 Marks** **End_Semester :70 Marks**

Prerequisite Courses, if any: ---

Companion Course, if any:---

Course Objectives:

- Understand the biophysical basis of non-invasive brain signals
- To apply signal processing, discrimination, and classification tools to interpret these signals
- To implement these tools into a control system for a brain-computer interface.

Course Outcomes:

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

CO1: Comprehend and appreciate the significance and role of this course in the present contemporary world.
CO2: Evaluate concept of BCI.
CO3: Assign functions appropriately to the human and to the machine.
CO4: Select appropriate feature extraction methods
CO5: Use machine learning algorithms for translation.
CO6: Learn the various applications of BCI

COURSE CONTENTS

Unit I	INTRODUCTION TO BCI	(07 hrs)

Introduction - Brain structure and function, Brain Computer Interface Types - Synchronous and Asynchronous -Invasive BCI -Partially Invasive BCI - Non Invasive BCI, Structure of BCI System, BCI Monitoring Hardware, EEG, ECoG, MEG, fMRI.

Mapping of Course Outcomes for Unit I	CO1

Unit II	BRAIN ACTIVATION	(06 hrs)

Brain activation patterns - Spikes, Oscillatory potential and ERD, Slow cortical potentials, Movement related potentials-Mu rhythms, motor imagery, Stimulus related potentials - Visual Evoked Potentials – P300 and Auditory Evoked Potentials, Potentials related to cognitive tasks.

Mapping of Course Outcomes for Unit II	CO2

Unit III	FEATURE EXTRACTION METHODS	(7 hrs)

Data Processing – Spike sorting, Frequency domain analysis, Wavelet analysis, Time domain analysis, Spatial filtering -Principal Component Analysis (PCA), Independent Component Analysis (ICA), Artefacts reduction, Feature Extraction - Phase synchronization and coherence

Mapping of Course Outcomes for Unit III	CO3	
Unit IV	**MACHINE LEARNING METHODS FOR BCI**	**(7 hrs)**

Classification techniques –Binary classification, Ensemble classification, Multiclass Classification, Evaluation of classification performance, Regression - Linear, Polynomial, RBF's, Perceptron's, Multilayer neural networks, Support vector machine, Graph theoretical functional connectivity analysis.

Mapping of Course Outcomes for Unit IV	CO4	
Unit V	**BCI BASED ON ONSET AND OFFSET VEP**	**(7 hrs)**

Introduction- Methods- Peak-to-valley amplitudes in the onset and offset FVEPs, Determination of gazed target, Usability of Transient VEPs in BCIs- VEPs, Availability of transient VEPs, Machine learning approach.

Mapping of Course Outcomes for Unit V	CO5	
Unit VI	**APPLICATIONS OF BCI**	**(7 hrs)**

Case Studies - Invasive BCIs: decoding and tracking arm (hand) position, controlling prosthetic devices such as orthotic hands, Cursor and robotic control using multi electrode array implant, Cortical control of muscles via functional electrical stimulation. Noninvasive BCIs:P300 Mind Speller, Visual cognitive BCI, Emotion detection. Ethics of Brain Computer Interfacing.

Mapping of Course Outcomes for Unit VI	CO6	
	Text Books:	

1. Reza Fazel-Rezai, "Recent Advances in Brain-Computer Interface Systems",Intech Publications, First Edition, 2011.
2. Theodre Berger W, John k Chapin et all, "Brain computer interfaces, An International assessment of research and developmental trends", Springer, First Edition, 2008.
3. Rajesh.P.N.Rao, Brain-Computer Interfacing: An Introduction, Cambridge University Press, First edition, 2013.
4. Jonathan Wolpaw, Elizabeth Winter Wolpaw, Brain Computer Interfaces: Principles and practice, Oxford University Press, USA, Edition 1, January 2012.
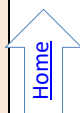
Reference Books:
1. Ella Hassianien, A &Azar.A.T (Editors), "Brain-Computer Interfaces Current Trends and Applications", Springer, 2015.
2. Bernhard Graimann, Brendan Allison, GertPfurtscheller, "Brain-Computer Interfaces: Revolutionizing Human-Computer Interaction", Springer, 2010
3. Ali Bashashati, Mehrdad Fatourechi, Rabab K Ward, Gary E Birch," A survey of signal Processing algorithms in brain–computer interfaces based on electrical brain signals" Journal of Neural Engineering, Vol.4, 2007, PP.32-57
4. Arnon Kohen, "Biomedical Signal Processing", Vol I and II, CRC Press Inc, Boca Rato, Florida.
5. Bishop C.M., "Neural networks for Pattern Recognition", Oxford, Clarendon Press, 1995.
6. Andrew Webb, "Statistical Pattern Recognition", Wiley International, Second Edition, 2002.

Savitribai Phule Pune University, Pune **Third Year of Artificial Intelligence and Machine Learning (2020 Course)** **318555: Elective II (C) - AI for Cyber Security**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory (TH) : 3 hrs/week	**03 Credits**	**Mid_Semester : 30 Marks** **End_Semester : 70 Marks**

Prerequisite Courses: 318548: Elective - I –Information Security

Companion Course: 318557: Software Laboratory III

Course Objectives:

- To learn the fundamental of AI and Cyber Security.
- To understand the cyber security threats and malware threats with AI.
- To understand and learn network anomaly detection techniques to machine learning problems.
- To understand and learn various algorithms to protect the sensitive information.
- To learn tools for the various GANs attacks.
- To understand and learn the evaluation of algorithms

Course Outcomes:

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

CO1: Understand the fundamental of AI and Cyber Security.

CO2: Analyze the cyber security threats and malware threats with AI.

CO3: Analyze and apply network anomaly detection techniques to machine learning problems.

CO4: Apply various algorithms to protect the sensitive information.

CO5: Understand and apply tools for the various GANs attacks.

CO6: Understand to evaluate algorithms.

COURSE CONTENTS		
Unit I	**INTRODUCTION**	**(06 hrs)**

Applying AI in cyber security, The evolution from expert systems to data mining and AI, The different forms of automated learning, The characteristics of algorithm training and optimization, Introducing AI in the context of cyber security, security measures using AI.

Mapping of Course Outcomes for Unit I	**CO1**	
Unit II	**DETECTING CYBER SECURITY THREATS WITH AI**	**(07 hrs)**

Detecting Email Cyber security Threats with AI: How to detect spam with Perceptrons, Image spam detection with support vector machines (SVMs), Phishing detection with logistic regression and decision trees, Spam detection with Naive Bayes, Spam detection adopting NLP. **Malware Threat Detection:** Introducing the malware analysis methodology, different malware families apart, Decision tree malware detectors, Detecting metamorphic malware with Hidden Markov Models (HMMs), Advanced malware detection with deep learning.

Mapping of Course Outcomes for Unit II	CO2	
Unit III	NETWORK ANOMALY DETECTION WITH AI	(06 hrs)

Network Anomaly Detection with AI: Network anomaly detection techniques, How to classify network attacks, Detecting botnet topology, Different machine learning (ML) algorithms for botnet detection.

Mapping of Course Outcomes for Unit III	CO3	
Unit IV	PROTECTING SENSITIVE INFORMATION AND ASSETS	(06 hrs)

Securing User Authentication: Authentication abuse prevention, Account reputation scoring, User authentication with keystroke recognition, and Biometric authentication with facial recognition,

Fraud Prevention with Cloud AI Solutions: leverage machine learning (ML) algorithms for fraud detection, bagging and boosting techniques can improve an algorithm's effectiveness.

Mapping of Course Outcomes for Unit IV	CO4	
Unit V	GANS – ATTACKS AND DEFENSES	(06 hrs)

The fundamental concepts of GANs and their use in attack and defense scenarios, The main libraries and tools for developing adversarial examples, Attacks against deep neural networks (DNNs) via model substitution, Attacks against intrusion detection systems (IDS) via GANs, Attacks against facial recognition procedures using adversarial examples.

Mapping of Course Outcomes for Unit V	CO5	
Unit VI	EVALUATING ALGORITHMS	(06 hrs)

Feature engineering best practices in dealing with raw data, evaluate a detector's performance using the ROC curve, split sample data into training and test sets, manage algorithms' overfitting and bias–variance trade-offs with cross.

Mapping of Course Outcomes for Unit VI	CO6	
Text Books:		

1. Daniel Ventre, "Artificial Intelligence, Cyber security and Cyber Defense", Wiley-ISTE publication
2. Clarence Chio, David Freeman " Machine Learning and Security", O'Reilly Media, Inc

| **Reference Books:** | | |

1. Alessandro Parisi, "Hands-On Artificial Intelligence for Cybersecurity", Packt Publishing.
2. Gupta, Brij Sheng, Quan Z, "Machine learning for computer and cyber security principles, algorithms, and practices" CRC Press, ISBN - 978-1-138-58730-4

SavitribaiPhule Pune University, Pune
Third Year of Artificial Intelligence and Machine Learning (2020 Course)
318555: Elective II (D) -: Video Analytics

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory (TH) : 3 hrs/week	**03 Credits**	**Mid_Semester : 30 Marks** **End_Semester : 70 Marks**

Prerequisite Courses, if any: ---

Companion Course, if any:---

Course Objectives:

At the end of the course, the students will be able to-
1. Understand the need for video Analytics
2. Understand the basic configuration of video analytics
3. Understand the functional blocks of a video analytic system
4. Get exposed to the various applications of video analytics

Course Outcomes:

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

CO1: Understand the algorithms available for performing analysis on video data and address the challenges
CO2: Design video analytic algorithms for security applications
CO3: Design video analytic algorithms for business intelligence
CO4: Design custom made video analytics system for the given target application
CO5: Analyse the Images using various Coding Techniques

COURSE CONTENTS		
Unit I	**VIDEO ANALYTIC COMPONENTS**	**(06 hrs)**

Need for Video Analytics-Overview of video Analytics- Foreground extraction- Feature extraction- classifier - Pre-processing- edge detection- smoothening- Feature space-PCA-FLD-SIFT features

Mapping of Course Outcomes for Unit I	CO1	
Unit II	**FOREGROUND EXTRACTION**	**(06 hrs)**

Background estimation- Averaging- Gaussian Mixture Model- Optical Flow based- Image Segmentation- Region growing- Region splitting-Morphological operations- erosion-Dilation- Tracking in a multiple camera environment.

Mapping of Course Outcomes for Unit II	CO2	
Unit III	**CLASSIFIERS**	**(06 hrs)**

Neural networks (back propagation) - Deep learning networks- Fuzzy Classifier- Bayesian classifier-HMM based classifier.

Mapping of Course Outcomes for Unit III	CO3	
Unit IV	VIDEO ANALYTICS FOR SECURITY	(06 hrs)

Abandoned object detection- human behavioural analysis -human action recognition- perimeter security- crowd analysis and prediction of crowd congestion.

Mapping of Course Outcomes for Unit IV	CO4	
Unit V	VIDEO ANALYTICS FOR BUSINESS INTELLIGENCE & TRAFFIC MONITIRING AND ASSISTANCE	(06 hrs)

Customer behaviour analysis - people counting- Traffic rule violation detection- traffic congestion identification for route planning- driver assistance- lane change warning

Mapping of Course Outcomes for Unit V	CO5	
Unit VI	VIDEO ANALYSIS ACTION RECOGNITION	(06 hrs)

Video Analysis Action Recognition, Video based rendering, Context and scene understanding. Case Study: Surveillance - Advanced Driver Assistance System

Mapping of Course Outcomes for Unit VI	CO6	

Text Books:
1. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer, 2011.
2. Raeme A. Jones (Editor), Nikos Paragios (Editor), Carlo S. Regazzoni (Editor) Video-Based Surveillance Systems: Computer Vision and Distributed Processing , Kluwer academic publisher, 2001
3. Ilanjan Dey (Editor), Amira Ashour (Editor) and Suvojit Acharjee (Editor), Applied Video Processing in Surveillance and Monitoring Systems (IGI global) 2016
Reference Books:
1. Hihao Chen (Author), Ye Yang (Author), Jingyu Xue (Author), Liping Ye (Author), Feng Guo (Author), The Next Generation of Video Surveillance and Video Analytics: The Unified Intelligent Video Analytics Suite, CreateSpace Independent Publishing Platform, 2014
2. Aifeng Shan (Editor), Fatih Porikli (Editor), Tao Xiang (Editor), Shaogang Gong (Editor) Video Analytics for Business Intelligence, Springer, 2012
3. Murat Tekalp, "Digital Video Processing", Second Edition, Prentice Hall, 2015.
4. Oguslaw Cyganek,"Object Detection and Recognition in Digital Images: Theory and Practice", Wiley 2013

Savitribai Phule Pune University, Pune
Third Year of Artificial Intelligence and Machine Learning (2020 Course)
318556: Software Laboratory II

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Practical (PR) : 04 hrs./week	**1 Credit**	**PR : 25 Marks** **TW : 50 Marks**

Companion Course: 318552: Machine Intelligence for Data Science, 318554: Artificial Neural Network

Course Objectives :

- Students will demonstrate proficiency with statistical analysis of data.
- Students will execute statistical analyses with professional statistical software.
- Students will apply data science concepts and methods to solve problems.

Course Outcomes :

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

CO1: Demonstrate proficiency with statistical analysis of data.

CO2: Use statistical analyses with professional statistical software.

CO3: Apply data science concepts and methods to solve problems.

Guidelines for Instructor's Manual

Lab Assignments: Following is a list of suggested laboratory assignments for reference. Laboratory Instructors may design a suitable set of assignments for their respective courses at their level. Beyond curriculum assignments, the mini-project is also 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. 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).

Guidelines for Student's Lab 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 journals may be avoided. Submission of journal/ term work in the form of softcopy is desirable and appreciated.

Guidelines for Lab /TW Assessment

Term work is continuous assessment that evaluates a student's progress throughout the semester. 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 an internal monthly Oral examination as part of continuous assessment.

Guidelines for Laboratory Conduction

Following is a list of suggested laboratory assignments for reference. Laboratory Instructors may design a suitable set of assignments for respective courses at their level. Beyond curriculum assignments may be included as a part of laboratory work. 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. 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. 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 tutorials may be as per guidelines of authority. **Use of open source software is to be encouraged.**

Guidelines for Practical Examination

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.

List of Laboratory Assignments

Group A (Any 4) (Based on Machine intelligence for Data Science)

Assignment 1: Access an open source dataset "Titanic". Apply pre-processing techniques on the raw dataset.

Assignment 2: Text classification for Sentimental analysis using KNN. (Refer any dataset like Titanic, Twitter, etc.)

Assignment 3: Write a program to recognize a document is positive or negative based on polarity words using suitable classification method.

Assignment 4: Download Abalone dataset. (URL: http://archive.ics.uci.edu/ml/datasets/Abalone)

　　a) Predict the number of rings either as a continuous value or as a classification problem.
　　b) Predict the age of abalone from physical measurements using linear regression

Assignment 5: We have given a collection of 8 points.

　　　　P1=[0.1,0.6]
　　　　P2=[0.15,0.71]
　　　　P3=[0.08,0.9]
　　　　P4=[0.16, 0.85]
　　　　P5=[0.2,0.3]
　　　　P6=[0.25,0.5]
　　　　P7=[0.24,0.1]
　　　　P8=[0.3,0.2]

　　Perform the k-mean clustering with initial centroids as m1=P1 =Cluster#1=C1 and m2=P8=cluster#2=C2.
　　Answer the following
　　1] Which cluster does P6 belong to?

2] What is the population of cluster around m2?

3] What is updated value of m1 and m2?

Group B (Any 4) (Based on Artificial Neural Network))
Assignment 1: Write a program to scheme a few activation functions that are used in neural networks
Assignment 2: Write a program to show back propagation network for XOR function with binary input and output
Assignment 3: Write a program for producing back propagation feed forward network
Assignment 4: Write a program to demonstrate ART
Assignment 5: Write a program to demonstrate the perceptron learning law with its decision region using python. Give the output in graphical form

Savitribai Phule Pune University, Pune **Third Year of Artificial Intelligence and Machine Learning (2020 Course)** **318557: Software Lab III- DMW & Industrial Internet of Things**		
Teaching Scheme: **Practical (PR) : 04 hrs/week**	**Credit Scheme:** **01 Credit**	**Examination Scheme:** PR : 25 Marks TW : 50 Marks

Prerequisites:

Course Objectives :

- Understand the detailed aspects of data warehousing and data mining.
- Fully understand IoT/IIoT workflow. Gain deep knowledge in cloud computing (IBM, PTC), IoT dashboards.
- Understand the crucial points in IIoT.
- Strengthen fundamental knowledge for Electrical Engineering, Computer Science and Business Administration specializations.

Course Outcomes :

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

CO1: Ability to understand the various kinds of tools.

CO2: Demonstrate the classification, clustering and etc. in large data sets.

CO3: Ability to add mining algorithms as a component to the exiting tools.

CO4: To learn physical design, logical design and enabling technologies of internet of things.

CO5: To acquire knowledge about IoT platforms.

Guidelines for Instructor's Manual

The faculty member should prepare the laboratory manual for all the experiments and it should be made available to students and laboratory instructor/Assistant.

Guidelines for Student's Lab Journal

1. Student should submit term work in the form of handwritten journal based on specified list of assignments.
2. Practical Examination will be based on the term work.
3. Candidate is expected to know the theory involved in the experiment.
4. The practical examination should be conducted if and only if the journal of the candidate is complete in all aspects.

Guidelines for Lab /TW Assessment

1. Examiners will assess the term work based on performance of students considering the parameters such as timely conduction of practical assignment, methodology adopted for implementation of practical assignment, timely submission of assignment in the form of handwritten write-up along with results of implemented assignment, attendance etc.
2. Examiners will judge the understanding of the practical performed in the examination by asking some questions related to the theory & implementation of the experiments he/she has carried out.
 3. Appropriate knowledge of usage of software and hardware related to respective laboratory should be checked by the concerned faculty member.

Guidelines for Laboratory Conduction
As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers of the program in journal may be avoided. There must be hand-written write-ups for every assignment in the journal. The DVD/CD containing students programs should be attached to the journal by every student and same to be maintained by department/lab In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory. It is expected that student should implement concept of Data Mining and Warehousing. The open source Data Mining Tools like Rapid Miner, Weka etc. can be used to implement the concept of Data Mining and Warehousing.
Guidelines for Practical Examination
1. There will be 2 problem statements options and student will have to perform any one.   2. All the problem statements carry equal weightage.
List of Laboratory Assignments
Group A(DMWL)
Any seven Assignments are compulsory*   **Assignment No 1:** Build Data Warehouse and Explore WEKA   **Assignment No 2:** Perform data preprocessing tasks and Demonstrate performing association rule mining on data sets   **Assignment No 3:** Demonstration of classification rule process on WEKA data-set using Naive Bayes algorithm.   **Assignment No 4:** Implementation of OLAP operations   **Assignment No 5:** Demonstrate performing Regression on data sets   **Assignment No 6:** Demonstration of clustering rule process on data-set iris.arff using simple k-means   **Assignment No 7:** Demonstration of any ETL tool   **Assignment No 8:** Write a program of Apriori algorithm using any programming language.   **Assignment No 9:** Case Study on Text Mining or any commercial application.
List of Laboratory Assignments
Group B(IIOTL)
Following practical can be performed on Raspberry Pi &/ Arduino Board(Any 3)   1. Making On and OFF of LED.   2. Interfacing of LCD.   3. Reading and displaying Analogue input voltage.   4. LED intensity variation depending upon potentiometer variation.   5. Speed variation of dc motor.

Any two on application like

1. Interfacing of Raspberry Pi &/ Arduino Board with computer using any protocol.
2. Interfacing of sensor and sending data to mobile as SMS or to computer.
3. Wireless communication between two boards.
4. Sending sensor data to google sheets or any spread sheet. Etc

Text Books

1. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications
2. Bernd Scholz-Reiter, Florian 2. Michahelles, "Architecting the Internet of Things", ISBN 978-3-642-19156-5 e-ISBN 978-3-642-19157-2, Springer
3. Data Mining: Concepts and Techniques by Margaret Dunham, Morgan Kaufmann Publication.
4. Data Warehousing Fundamentals by Paul Punnian, John Wiley Publication.

Industrial Internet of Things

1.
   rshdeep Bahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015.

2.
   Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications.

3.
   drian McEwen , Designing The Internet of Things, Willy Pubication.

4.
   aj Kamal, Internet of Things, McGraw Hill Education. 5. Nuno Corriea and Ajay N, Internet of Things with SAP HANA: Build Your IoT Use Case With Raspberry PI, Arduino Uno, HANA XSJS and SAPUI5, publisher UI5 Community Network.

5.
   Timothy Chou, Precision Internet of Things, Mcgraw Hill Education.

Reference Books

1. Hakima Chaouchi, " The Internet of Things Connecting Objects to the Web" ISBN : 978-1- 84821-140-7, Willy Publications
2. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things: Key Applications and Protocols, ISBN: 978-1-119-99435-0, 2 nd Edition, Willy Publications
3. Inside the Internet of Things (IoT), Deloitte University Press.
4. Data Warehousing, Data Mining and OLAP by Alex Berson, S.J. Smith, Tata McGraw Hill
5. Daniel Kellmereit, Daniel Obodovski, "The Silent Intelligence: The Internet of Things", Publisher: Lightning Source Inc; 1 edition (15 April 2014). ISBN-10: 0989973700, ISBN13: 978- 0989973700.
6. Fang Zhaho, Leonidas Guibas, "Wireless Sensor Network: An information processing approach", Elsevier, ISBN: 978-81-8147-642-5.

Savitribai Phule Pune University, Pune
Third Year of Artificial Intelligence and Machine Learning (2020 Course)
318557: Software Lab III- DMW & Brain Computer Interface

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Practical (PR) : 04 hrs/week	**01 Credit**	**PR : 25 Marks** **TW : 50 Marks**

Prerequisites:

Course Objectives :
- Understand the detailed aspects of data warehousing and data mining.
- Understand the basic concepts of brain computer interface, interface types, EEG signals.
- Study the state of art in neuroimaging-based approaches and their related applications and Brain Computer Interface system.
- Demonstrate the concept of Data Streaming and Data Processing using suitable tool.
- Understand the ethical issues pertaining to the development and use of Brain Computer Interface technology.

Course Outcomes :

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

CO1: Demonstrate the classification, clustering and etc. in large data sets.

CO2: Ability to add mining algorithms as a component to the exiting tools.

CO3: Study the utilization of drives system related to the electroencephalogram (EEG) signals for neuro rehabilitation.

CO4: Understand the concept of Brain Computer Interface Systems that can be designed and developed with the overall goal of supporting a wide range of users for a wide range of applications.

CO5: Process multi-channel EEG data using a suitable tool in the computing environment which will be helpful for developing, prototyping and testing Brain Computer Interface approaches.

 CO6: Solve the interoperability and standardization issues of Brain Computer Interface software platforms and to identify and design new applications of Brain Computer Interface.

Guidelines for Instructor's Manual
The faculty member should prepare the laboratory manual for all the experiments and it should be made available to students and laboratory instructor/Assistant.
Guidelines for Student's Lab Journal
1. Student should submit term work in the form of handwritten journal based on specified list of assignments.   2. Practical Examination will be based on the term work.   3. Candidate is expected to know the theory involved in the experiment.   4. The practical examination should be conducted if and only if the journal of the candidate is complete in all aspects.

Guidelines for Lab /TW Assessment
1. Examiners will assess the term work based on performance of students considering the parameters such as timely conduction of practical assignment, methodology adopted for implementation of practical assignment, timely submission of assignment in the form of handwritten write-up along with results of implemented assignment, attendance etc.   2. Examiners will judge the understanding of the practical performed in the examination by asking some questions related to the theory & implementation of the experiments he/she has carried out.   3. Appropriate knowledge of usage of software and hardware related to respective laboratory should be checked by the concerned faculty member.
Guidelines for Laboratory Conduction
As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers of the program in journal may be avoided. There must be hand-written write-ups for every assignment in the journal. The DVD/CD containing students programs should be attached to the journal by every student and same to be maintained by department/lab In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory. It is expected that student should implement concept of Data Mining and Warehousing. The open source Data Mining Tools like Rapid Miner, Weka etc. can be used to implement the concept of Data Mining and Warehousing.
Guidelines for Practical Examination
1. There will be 2 problem statements options and student will have to perform any one.   2. All the problem statements carry equal weightage.
List of Laboratory Assignments
Group A(DMWL)
Any seven Assignments are compulsory*   **Assignment No 1:** Build Data Warehouse and Explore WEKA   **Assignment No 2:** Perform data preprocessing tasks and Demonstrate performing association rule mining on data sets   **Assignment No 3:** Demonstration of classification rule process on WEKA data-set using Naive Bayes algorithm.   **Assignment No 4:** Implementation of OLAP operations   **Assignment No 5:** Demonstrate performing Regression on data sets   **Assignment No 6:** Demonstration of clustering rule process on data-set iris.arff using simple k-means   **Assignment No 7:** Demonstration of any ETL tool   **Assignment No 8:** Write a program of Apriori algorithm using any programming language.   **Assignment No 9:** Case Study on Text Mining or any commercial application.

List of Laboratory Assignments
Group B(Brain Computer Interface)
Mini Project(Any One)

Application with innovative idea is expected

Continuous Assessment based on a minimum of 3 reviews.

Sample projects that can be given to students to be implemented using Python, Raspberry Pi, Arduino etc.

1. Brain Controlled Home Automation using Raspberry Pi
2. Brain Controlled Robotic Arm
3. Brain Control Robot using Arduino
4. BCI Virtual Keyboard using Raspberry Pi
5. BCI Based Password Validation

Text Books

6. Data Mining: Concepts and Techniques by Margaret Dunham, Morgan Kaufmann Publication.
7. Data Warehousing Fundamentals by Paul Punnian, John Wiley Publication. Brain-Computer Interfaces Current Trends and Applications, Aboul Ella Hassanien, Ahmad Taher Azar, Volume 74, Springer International Publishing2015, ISBN: 978-3-319-10977-0, DOI:10.1007/978-3- 319-10978-7
8. Brain Computer Interfaces-Applying Your Minds to Human-Computer Interaction, Desney S. Tan, Anton Nijholt, ISBN: 978-1-84996-271-1, DOI: 10.1007/978-1-84996-272-8
9. Brain–Computer Interfaces Handbook-Technological and Theoretical Advances, Chang S. Nam,Anton Nijholt, Fabien Lotte, Taylor & Francis 2018, ISBN: 13: 978-1-4987-7343-0

Reference Books

1. Data Warehousing, Data Mining and OLAP by Alex Berson, S.J. Smith, Tata McGraw Hill
2. Brain-Computer Interfacing -an Introduction, Rajesh P. N. Rao, 2013, ISBN: 978-0-521-76941-9

Savitribai Phule Pune University, Pune
Third Year of Artificial Intelligence and Machine Learning (2020 Course)
318557: Software Lab III- DMW & AI for Cyber Security

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Practical (PR) : 04 hrs/week	**01 Credit**	**PR : 25 Marks**
		TW : 50 Marks

Prerequisites: ---

Course Objectives :
- Students will demonstrate proficiency with statistical analysis of data.
- Students will execute statistical analyses with professional statistical software.
- Students will apply data science concepts and methods to solve problems.
- Understand the detailed aspects of data warehousing and data mining.

Course Outcomes :

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

CO1: Ability to understand the various kinds of tools.

CO2: Demonstrate the classification, clustering and etc. in large data sets.

CO3: Ability to add mining algorithms as a component to the exiting tools.

CO4: Demonstrate proficiency with statistical analysis of data.

CO5: Use statistical analyses with professional statistical software.

CO6: Apply data science concepts and methods to solve problems.

Guidelines for Instructor's Manual
The faculty member should prepare the laboratory manual for all the experiments and it should be made available to students and laboratory instructor/Assistant.
Guidelines for Student's Lab Journal
1. Student should submit term work in the form of handwritten journal based on specified list of assignments.   2. Practical Examination will be based on the term work.   3. Candidate is expected to know the theory involved in the experiment.   4. The practical examination should be conducted if and only if the journal of the candidate is complete in all aspects.
Guidelines for Lab /TW Assessment
1. Examiners will assess the term work based on performance of students considering the parameters such as timely conduction of practical assignment, methodology adopted for implementation of practical assignment, timely submission of assignment in the form of handwritten write-up along with results of implemented assignment, attendance etc.   2. Examiners will judge the understanding of the practical performed in the examination by asking some questions related to the theory & implementation of the experiments he/she has carried out.   3. Appropriate knowledge of usage of software and hardware related to respective laboratory should be checked by the concerned faculty member.
Guidelines for Laboratory Conduction

As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers of the program in journal may be avoided. There must be hand-written write-ups for every assignment in the journal. The DVD/CD containing students programs should be attached to the journal by every student and same to be maintained by department/lab In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory. It is expected that student should implement concept of Data Mining and Warehousing. The open source Data Mining Tools like Rapid Miner, Weka etc. can be used to implement the concept of Data Mining and Warehousing.

Guidelines for Practical Examination

1. There will be 2 problem statements options and student will have to perform any one.
2. All the problem statements carry equal weightage.

List of Laboratory Assignments

Group A(DMWL)

Any seven Assignments are compulsory*

Assignment No 1: Build Data Warehouse and Explore WEKA

Assignment No 2: Perform data preprocessing tasks and Demonstrate performing association rule mining on data sets

Assignment No 3: Demonstration of classification rule process on WEKA data-set using Naive Bayes algorithm.

Assignment No 4: Implementation of OLAP operations

Assignment No 5: Demonstrate performing Regression on data sets

Assignment No 6: Demonstration of clustering rule process on data-set iris.arff using simple k-means

Assignment No 7: Demonstration of any ETL tool

Assignment No 8: Write a program of Apriori algorithm using any programming language.

Assignment No 9: Case Study on Text Mining or any commercial application.

List of Laboratory Assignments

Group B(AI for Cyber Security)

Assignment 1: Build a spam filter using Python and the Naive Bayes algorithm.

Assignment 2: Classify DDoS attacks with Artificial Intelligence.

Assignment 3: Split sample data into training and test sets. (Use suitable data set).

Assignment 4: Perform feature engineering operations on raw data. (Use suitable data set).

Text Books

1.
    ata Mining: Concepts and Techniques by Margaret Dunham, Morgan Kaufmann Publication.
2.
    ata Warehousing Fundamentals by Paul Punnian, John Wiley Publication.
3. Daniel Ventre, "Artificial Intelligence, Cyber security and Cyber Defense", Wiley-ISTE publication
4. Clarence Chio, David Freeman " Machine Learning and Security", O'Reilly Media, Inc.

Reference Books
1.
ata Warehousing, Data Mining and OLAP by Alex Berson, S.J. Smith, Tata McGraw Hill
2.
lessandro Parisi, "Hands-On Artificial Intelligence for Cyber Security", Packt Publishing.
3.
upta, Brij Sheng, Quan Z, "Machine Learning for Computer and Cyber Security Principles, Algorithms, and Practices" CRC Press, ISBN - 978-1-138-58730-4

Savitribai Phule Pune University, Pune Third Year of Artificial Intelligence and Machine Learning (2020 Course) **318557: Software Lab III- DMW & Video Analytics**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical (PR) : 04 hrs/week	**01 Credit**	**PR : 25 Marks** **TW : 50 Marks**

Prerequisites:

Course Objectives :
• To develop critical thinking and engineering problem solving skills amongst the students. • To explain the roles and responsibilities of IT engineers to the solution of engineering problems within the social, environmental and economic context. • Understand the detailed aspects of data warehousing and data mining.

Course Outcomes :
On completion of the course, students will be able to– **CO1:** Design solution to real life problems and analyze its concerns through shared cognition. CO2: Apply learning by doing approach in Video Analytics to promote lifelong learning. CO3: Tackle technical challenges for solving real world problems with team efforts. CO4: Collaborate and engage in multi-disciplinary learning environments. CO5: Demonstrate the classification, clustering and etc. in large data sets. CO6: Ability to add mining algorithms as a component to the exiting tools.

Guidelines for Instructor's Manual
The faculty member should prepare the laboratory manual for all the experiments and it should be made available to students and laboratory instructor/Assistant.

Guidelines for Student's Lab Journal
1. Student should submit term work in the form of handwritten journal based on specified list of assignments. 2. Practical Examination will be based on the term work. 3. Candidate is expected to know the theory involved in the experiment. 4. The practical examination should be conducted if and only if the journal of the candidate is complete in all aspects. 5. For Video Analytics Mini project, group structure should enable students to work in mentor–monitored groups. The students plan, manage and complete a task/project / activity which address the stated problem. 6. There should be a team of 3 to 4 students who will work cohesively. 7. A Mentor should be assigned to individual groups who will help them with learning and development process.

Guidelines for Lab /TW Assessment
1. Examiners will assess the term work based on performance of students considering the parameters such as timely conduction of practical assignment, methodology adopted for implementation of practical assignment, timely submission of assignment in the form of handwritten write-up along with results of implemented assignment, attendance etc. 2. Examiners will judge the understanding of the practical performed in the examination by asking

some questions related to the theory & implementation of the experiments and mini project he/she has carried out.

3. Appropriate knowledge of usage of software and hardware related to respective laboratory should be checked by the concerned faculty member.

Guidelines for Laboratory Conduction

As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers of the program in journal may be avoided. There must be hand-written write-ups for every assignment in the journal. The DVD/CD containing students programs should be attached to the journal by every student and same to be maintained by department/lab In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory. It is expected that student should implement concept of Data Mining and Warehousing. The open source Data Mining Tools like Rapid Miner, Weka etc. can be used to implement the concept of Data Mining and Warehousing.

Guidelines for Practical Examination

1. There will be 2 problem statements options and student will have to perform any one.
2. All the problem statements carry equal weightage.

List of Laboratory Assignments

Group A(DMWL)

Any seven Assignments are compulsory*

Assignment No 1: Build Data Warehouse and Explore WEKA

Assignment No 2: Perform data preprocessing tasks and Demonstrate performing association rule mining on data sets

Assignment No 3: Demonstration of classification rule process on WEKA data-set using Naive Bayes algorithm.

Assignment No 4: Implementation of OLAP operations

Assignment No 5: Demonstrate performing Regression on data sets

Assignment No 6: Demonstration of clustering rule process on data-set iris.arff using simple k-means

Assignment No 7: Demonstration of any ETL tool

Assignment No 8: Write a program of Apriori algorithm using any programming language.

Assignment No 9: Case Study on Text Mining or any commercial application.

List of Laboratory Assignments

Group B(Video Analytics)-Mini Project

Application with innovative idea is expected
Continuous Assessment based on a minimum of 3 reviews.

Sample projects that can be given to students to be implemented using OpenCV/Python/Octave/C/Java etc:
1. Image enhancement applications
2. Object/image recognition applications based on digital image transforms
3. Image analysis systems for visual inspection tasks (object recognition)
4. Image compression, Image Fusion
5. Image Steganography, Watermarking
6. Applications of Image Intelligence in: Medicine, Microscopy, Remote sensing, Astronomy, Materials science, Security, Robotics, Optical character recognition, Metallography etc
7. Defense– Smart Surveillance and Tracking
8. ADAS – Sign Board Detection, Traffic Monitoring, Fatigue Detection, Navigation, Lane detection
9.Image Captioning and Visual Question Answering
10.Gesture Recognition

Text Books
1. Mark Nixon and Alberto S. Aquado, "Feature Extraction & Image Processing for Computer Vision", ThirdEdition, Academic Press, 2012.   2. Data Mining: Concepts and Techniques by Margaret Dunham, Morgan Kaufmann Publication.   3. Data Warehousing Fundamentals by Paul Punnian, John Wiley Publication.

Reference Books
1. Data Warehousing, Data Mining and OLAP by Alex Berson, S.J. Smith, Tata McGraw Hill   2. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer, 2010

E Books / E Learning References
Links for image database-Video Analytics: 1. http://homepages.inf.ed.ac.uk/rbf/CVonline/Imagedbase.htm   2. https://www.cs.cmu.edu/~cil/v-images.html   3. http://www.imageprocessingplace.com/root_files_V3/image_databases.htm   4. https://gengo.ai/datasets/20-best-image-datasets-for-computer-vision

Savitribai Phule Pune University, Pune		
Third Year of Artificial Intelligence and Machine Learning (2020 Course)		
318558: Internship / Skill Development / Global Certification Program		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical (PR) : 8 hrs/week	**06**	**Term Work(TW): 50 Marks** **Oral(OR): 50 Marks**

Prerequisites: Permission of the College Internship Coordinator/TPO.

Course Objectives :

Internship provides an excellent opportunity to learner to see how the conceptual aspects learned in classes are integrated into the practical world. Industry/on project experience provides much more professional experience as value addition to classroom teaching.

- To encourage and provide opportunities for students to get professional/personal experience through internships.
- To learn and understand real life/industrial situations.
- To get familiar with various tools and technologies used in industries and their applications.
- To nurture 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 internships to complete academic activities in a professional manner.

    CO3: To choose appropriate technology and tools to solve given problem.

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

    CO5: Creating network and social circle, and developing relationships with industry people.

    CO6: To analyze various career opportunities and decide carrier goals.

About the Course

Internships are educational and career development opportunities, providing practical experience in a field or discipline. Internships are far more important as the employers are looking for employees who are properly skilled and having awareness about industry environment, practices and culture. Internship is structured, short-term, supervised training often focused around particular tasks or projects with defined time scales.

Core objective is to expose technical students to the industrial environment, which cannot be simulated/experienced in the classroom and hence creating competent professionals in the industry and to understand the social, economic and administrative considerations that influence the working environment of industrial organizations.

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.

Guidelines for Instructor's

Internship Work Evaluation:

Instructor should keep track on internship activities and maintain the record of internship in the form of Internship Diary/ Internship Workbook.

The evaluation of these activities will be done by Programme Head/Cell In-charge/ Project Head/ faculty mentor or Industry Supervisor based on- Overall compilation of internship activities, sub-activities, and the level of achievement expected, evidence needed to assign the points and the duration for certain activities.

Assessment and Evaluation is to be done in consultation with internship supervisor (Internal and External – a supervisor from place of internship.

Recommended evaluation parameters-Post Internship Internal Evaluation -50 Marks + Internship Diary/Workbook and Internship Report - 50 Marks

Evaluation through Seminar Presentation/Viva-Voce at the Institute-

The student will give a seminar based on his training report, before an expert committee constituted by the concerned department as per norms of the institute. The evaluation will be based on the following criteria:

Depth of knowledge and skills: Communication and Presentation Skills

- Team Work
- Creativity
- Planning and Organizational skills
- Adaptability
- Analytical Skills
- Attitude and Behavior at work
- Societal Understanding
- Ethics
- Regularity and punctuality
- Attendance record
- Diary/Work book
- Student's Feedback from External Internship Supervisor

After completion of Internship, the student should prepare a comprehensive report to indicate what he has observed and learnt in the training period.

Internship   Diary/workbook may be evaluated on the basis of the following criteria: Proper and timely documented entries Adequacy & quality of information recorded Data recorded Thought process and recording techniques used Organization of the information.

The report shall be presented covering 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
- Results / Analysis /inferences and conclusion
- Suggestions / Recommendations for improvement to industry, if any
- Attendance Record
- Acknowledgement
- List of reference (Library books, magazines and other sources)

Feedback from internship supervisor (External and Internal)

Post internship, faculty coordinator should collect feedback about student with following recommended parameters-

Technical knowledge, Discipline, Punctuality, Commitment, Willingness to do the work, Communication skill, individual work, Team work, Leadership…..

Guidelines for Student's

Duration:

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

Internship work Identification:

Student may choose to undergo Internship at Industry/Govt. Organizations/NGO/MSME/Rural Internship/ Innovation/IPR/Entrepreneurship. Student may choose either to work on innovation or entrepreneurial activities resulting in start-up or undergo internship 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 from college authority well in advance. Internship work identification process should be initiated in the Vth semester in coordination with training and placement cell/ industry institute cell/ internship cell. This will help students to start their internship work on time. Also, it will allow students to work in vacation period after their Vth semester examination and before academic schedule of semester VI.

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

Working for consultancy/ research project, Contribution in Incubation/ Innovation/ Entrepreneurship Cell/ Institutional Innovation Council/ startups cells of institute /Learning at 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 internship, Participate in open source development.

Internship Diary/ Internship Workbook:

Students must maintain Internship Diary/ Internship Workbook. The main purpose of maintaining 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 to the Institute immediately after the completion of the training.

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

Savitribai Phule Pune University, Pune **Third Year of Artificial Intelligence and Machine Learning (2020 Course)** **318559: Seminar & Technical Communication**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Tutorial (TUT) : 01 hr/week	**1 Credit**	**OR : 25 Marks** **TW : 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, students will be able to–

CO1: Analyze a latest topic of professional interest.

CO2: Enhance technical writing skills.

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

CO4: Communicate with professional technical presentation skills.

Guidelines for Seminar Selection and Presentation

1) Student shall identify the area or topics in Information Technology referring to recent trends and developments in consultation with industry (for their requirement) and institute guide.

2) Student must review sufficient literature (reference books, journal articles, conference papers, white papers, magazines, web resources etc.) in relevant area on their topic as decided.

3) Seminar topics should be based on recent trends and developments. Guide should approve the topic by thoughtfully observing different techniques, comparative analysis of the earlier algorithms used or specific tools used by various researchers in the domain.

4) Research articles could be referred from IEEE, ACM, Science direct, Springer, Elsevier, IETE,CSI or from freely available digital libraries like Digital Library of India (dli.ernet.in), National Science Digital Library, JRD Tata Memorial Library, citeseerx.ist.psu.edu, getcited.org, arizona.openrepository.com, Open J-Gate, Research Gate, worldwidescience.org etc.

5) Student shall present the study as individual seminars in 20 – 25 minutes in English which is followed by Question Answer session.

6) Guide should ensure that students are doing literature survey and review in proper manner.

7) Guide should give appropriate instructions for effective presentation.

8) Attendance of all other students in the class for presentation is mandatory.

Timeline is suggested to follow throughout the semester:

1) Week– 01: Discussion to understand what is technical paper, how to search, where to search?

2) Week– 02: Download technical papers (minimum four), getting approved from Guide and Prepare abstract summary of all papers downloaded.

3) Week– 03 & 04: Read and understand in detail the decided research papers about the problem statement, techniques used, experimental details and results with conclusion from identified papers.

4) Week– 05: Review of the studied papers by Guide / Panel.

5) Week – 06 & 07: Search / Find equivalent techniques (other than the one proposed in technical paper)

so performance / complexities can be improved (by amortized analysis, not actual implementation).

6) Week – 08 & 09: Prepare presentation with outline as The topic, its significance, The research problem, Studied solutions (through research papers) with strengths and weaknesses of each solution, comparison of the solutions to research problem, future directions of work, probable problem statement of project, tentative plan of project work

7) Week – 10: Write Seminar report.

8) Week – 11: Deliver Presentation to Guide/ Panel.

9) Week –12: Verification of Seminar report and Submission

Guidelines for Seminar Report

1. Each student shall submit two copies of the seminar report in appropriate text editing tool/software as per prescribed format duly signed by the guide and Head of the department/Principal.

2. Broad contents of review report (20-25 pages) shall be

    a) 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, Year & University.

    b) Seminar Approval Sheet/Certificate.

    c) Abstract and Keywords.

    d) Acknowledgments.

    e) Table of Contents, List of Figures, List of Tables and Nomenclature.

    f) Chapters need to cover topic of discussion-

        i. Introduction with section including organization of the report,

        ii. Literature Survey

        iii. Motivation, purpose and scope and objective of seminar

        iv. Details of design/technology/Analytical and/or experimental work, if any/

        v. Discussions and Conclusions,

        vi. Bibliography/References (in IEEE Format),

        vii. Plagiarism Check report,

3. Students are expected to use open source tools for writing seminar report, citing the references and plagiarism detection.

Guidelines for Lab /TW Assessment

1. A panel of reviewers constituted by seminar coordinator (where guide is one of the member of the panel) will assess the seminar during the presentation.

2. Student's attendance for all seminars is advisable.

3. Rubric for evaluation of seminar activity:

    i. Relevance + depth of literature reviewed - 05 Marks

    ii. Seminar report (Technical Content) - 05 Marks

    iii. Seminar report (Language) - 05 Marks

    iv. Presentation & Communication Skills - 05 Marks
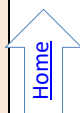
    v. Question and Answers - 05 Marks

Guidelines for Oral Examination

Both internal and external examiners should jointly conduct Oral examination. During assessment, the examiners should refer the rubrics given. The supplementary and relevant questions may be asked at the time of evaluation to judge the student's understanding of the fundamentals, effective communication.

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

Savitribai Phule Pune University, Pune
Third Year of Artificial Intelligence and Machine Learning (2020 Course)
318560(A): Mandatory Audit Course 4
The Science of Happiness

Teaching Scheme:	Credit Scheme:	Examination Scheme:
01hrs/week	Non Credit	Audit Course

Prerequisite Courses, if any: --

Everybody wants to be happy. One can explore innumerable ideas about what happiness is and how we can get some. But not many of those ideas are based on science. That's where this course comes in. The subject "Science of Happiness" aims to teach the pioneering science of positive psychology, which explores the ancestry of a happy and meaningful life. Clinical psychologists have been dealing with miserable feelings since their discipline was established. In the last 30 years, neuroscientists have made major headway in the understanding of the sources of anger, depression, and fear.

Today, whole industries profit from this knowledge—producing pills for every sort of pathological mood disturbance. But until recently, few neuroscientists focused on the subject of happiness. This course focuses on discovering how cutting-edge research can be applied to their lives. Students will learn about the Intra-disciplinary research supporting this view, spanning the fields of psychology, neuroscience, evolutionary biology, and beyond. The course offers students practical strategies for tapping into and nurturing their own happiness, including trying several research-backed activities that foster social and emotional well-being, and exploring how their own happiness changes along the way.

Course Objectives:

At the end of the course, the students will be able to-

5. To understand the feeling of happiness
6. To study the sources of positive feelings
7. To analyze the anatomy of the happiness system
8. To study the effect of thoughts and emotions on the happiness system

Course Outcomes:

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

CO1: Understand what happiness is and why it matters to you
CO2: Learn how to increase your own happiness
CO3: Understand of the power of social connections and the science of empathy
CO4: Understand what is mindfulness and its real world applications

COURSE CONTENTS

1. Happiness: what is it? ,
2. The secret of smiling
3. The autonomy of positive feelings
4. Positive feelings as a compass
5. The happiness system
6. Foundations: Emotions, Motivation and nature of Wellbeing
7. Subjective well being
8. Love and well being
9. Optimal well being
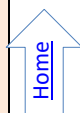10. Religion, Spirituality and wellbeing

Reference Books:
1.   Happier, Stefan Klein, "The Science of Happiness, How Our Brains Make Us Happy and what We Can Do to Get", Da Capo Press, ISBN 10: 156924328X, 13: 978-1569243282.
2. C. Compton, Edward Hoffman, "Positive Psychology: The Science of Happiness and Flourishing", William, Cengage Learning, 2012, ISBN10: 1111834121.
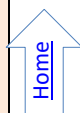
<table>
<tr><td colspan="3">**Savitribai Phule Pune University, Pune**
Third Year of Artificial Intelligence and Machine Learning (2020 Course)
Mandatory Audit Course 4
318560(B) - Emotional Intelligence</td></tr>
<tr><td>**Teaching Scheme:**</td><td>**Credit Scheme:**</td><td>**Examination Scheme:**</td></tr>
<tr><td>**01hrs/week**</td><td>**Non Credit**</td><td>**Audit Course**</td></tr>
</table>

Prerequisite Courses:

Course Objectives:
- To recognize the differences in the EI theories that is regularly applied in workplace initiatives.
- To understand the basic definitions, concerns and misunderstandings associated with emotional intelligence
- To understand Verbal and Non Verbal Communication Skill
- To acquire the social management skill and responsibility

Course Outcomes:

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

CO1: Analyze the differences in the EI theories that are regularly applied.

CO2: Describe components of emotional intelligence and identify them within behavior.

CO3: Acquire information and knowledge about responsibility for social management.

CO4: Communicate effectively (Verbal and Non Verbal) about emotional intelligence.

<table>
<tr><td colspan="3">**COURSE CONTENTS**</td></tr>
<tr><td>**Unit I**</td><td>**BASICS OF EMOTIONAL INTELLIGENCE**</td><td>**(2 hrs)**</td></tr>
<tr><td colspan="3">**Emotional Intelligence:** Concept of Emotional Intelligence, Understanding the history and origin of Emotional Intelligence, Contributors to Emotional Intelligence, Science of Emotional Intelligence, EQ and IQ, Scope of Emotional Intelligence.</td></tr>
<tr><td>**Mapping of Course Outcomes for Unit I**</td><td colspan="2">CO1</td></tr>
<tr><td>**Unit II**</td><td>**COMPONENTS OF EMOTIONAL INTELLIGENCE**</td><td>**(2 hrs)**</td></tr>
<tr><td colspan="3">**Components of Emotional Intelligence**: Self-awareness, Self-regulation, Motivation, Empathy, Social skills. Emotional Intelligence Competencies, Elements of Emotional Intelligence, Models of Emotional Intelligence: The Ability-based Model, The Trait Model of Emotional Intelligence, Mixed Models of Emotional Intelligence.</td></tr>
<tr><td>**Mapping of Course Outcomes for Unit II**</td><td colspan="2">CO2</td></tr>
</table>

Unit III	SOCIAL MANAGEMENT AND RESPONSIBILITY	(2 hrs)

Emotional Intelligence at Work place: Importance of Emotional Intelligence at Work place? Cost–savings of Emotional Intelligence, Emotionally Intelligent Leaders, Case Studies Measuring Emotional Intelligence: Emotionally Intelligence Tests, Research on Emotional Intelligence, Developing Emotional Intelligence.

Mapping of Course Outcomes for Unit III	CO3

Unit IV	VERBAL AND NON VERBAL COMMUNICATION SKILL	(2 hrs)

Verbal Communication skill: Focused listening, Asking questions, Communicating with flexibility and authenticity.
Non Verbal Communication skill: Body language: The signals you send others, It's not what you say, it's how you say it.

Mapping of Course Outcomes for Unit IV	CO4

Text Books:

1. The Emotionally Intelligent Manager: Author: David R. Caruso, Peter Salovey ,Publisher: John Wiley & Sons, Publish date: 2004
2. Working with Emotional Intelligence: Author: Daniel Goleman, Publisher: Bantam Doubleday Dell Group : 2000

Reference Books:

1. Emotional Intelligence at Work : Author: Hendrie Weisinger , Publisher: Jossey-Bass Publish Date: 1998
2. Emotional Intelligence Coaching: Author: Liz Wilson, Stephen Neale & Lisa Spencer-Arnell, Publisher: Kogan Page India Private Limited: 2012
3. The Student EQ Edge: Emotional Intelligence and Your Academic and Personal Success (Stein, Book & Kanoy)

Reference Books:

1. http://pdtraining.com.au/emotional-intelligence-training-course-in-brisbane-sydney-melbourne-canberra-adelaide-and-perth
2. In-house Training Instant Quote:
3. http://bookings.pdtraining.com.au/inhouseex1/quoterequestex1a.aspx

Evaluation:

Students should select any one of the topic in a group of 3 to 5. Students should submit a written report and make a presentation on the topic. The task should not be repeated among students. Report will be evaluated by the faculty as per rubrics defined by him/her/them at start of course.

SavitribaiPhule Pune University, Pune
Third Year of Artificial Intelligence and Machine Learning (2020 Course)
318560(C)- Language study-Module IV

Teaching Scheme:	Credit Scheme:	Examination Scheme:
01hrs/week	**Non Credit**	**Audit Course**

Prerequisite Courses, if any:
- Students must have already studied can read/write Hiragana and Katakana script
- Students must have studied Japanese for beginners that includes the syllabus of Audit course Module 1 to 3

Companion Course, if any:

Course Objectives:
- Japan Market needs: To meet the needs of ever growing industry with respect to the Japanese language support.
- Japanese Culture and Mindset: To get introduced to Japanese society and culture through language.
- Career opportunities: To know more about Higher studies, Career opportunities in Japan /Japanese Companies across the world.
- Soft skills and self-development: To learn the manners, business culture and develop the confidence by gaining the knowledge of global perspective and cross-cultural studies

Course Outcomes:

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

CO1: Do Better Communication in Japanese language.
CO2: Demonstrate knowledge of Japanese Language Scripts (Reading, Writing, etc).
CO3: Demonstrate knowledge of Japanese culture, lifestyle, etc.
CO4: Pursue advanced Professional Japanese Language course.

COURSE CONTENTS		
Unit I	JAPANESE GRAMMAR	Self-study) (3 hrs Lecture + 3 hrs
Receiving and Giving, Verb past tense, Negative, Make sentences using various adjectives, Culture/Others: Conversation/Essay about some place, Introduction to the tourism in Japan, Introduction to Business/Work culture in Japan, Kanjis: 41 to 50,Listening practice, Vocabulary and conversation practice		
Mapping of Course Outcomes for Unit I	CO2	
Unit II	INTERACTIVE JAPANESE	(Self-study) (3 hrs Lecture + 3 hrs
Adverbs of degree, Stating like / dislike, Living and Non-living things, Stating wish/desire, Stating the present action (verb te form), Culture/Others: Introduction to Career Opportunities, Education and Higher studies in Japan,Kanjis: 51 to 60,Listening practice, Vocabulary and conversation practice		

Mapping of Course Outcomes for Unit II	CO2	
Unit III	**FORMAL JAPANESE**	**(Self-study) (3 hrs Lecture + 3 hrs**
Counters , Making comparisons, Past tense of verbs ,Past tense of adjectives, Combining adjectives (i + i, na+i …), Culture/Others: Information about career forums and Job Fairs Introduction about Japanese companies recruitment process, Kanjis: 61 to 70, Listening practice, Vocabulary and conversation practice		
Mapping of Course Outcomes for Unit III	CO3	
Unit IV	**LIFE IN JAPAN**	**(3 hrs Lecture + 3 hrs)**
Stating wish/desire (ga hoshi, verb tai form), Stating / combining multiple actions (verb te form), Stating the order of multiple actions (verb te kara form),Expressing "Permission" and "Prohibition" (te mo ii, tewa ikenai forms),Culture/Others: Preparation of a job interview for a Japanese company, Do's and Don'ts in a Job Interview ,Kanjis: 71 to 80,Listening practice, Vocabulary and conversation practice		
Mapping of Course Outcomes for Unit IV	CO4	
Text Books:		
1. Minna no Nihongo I–MainText book with audio and video files (Books by Goyal Publishers – Available in shops / Online) **2.** Minna no Nihongo - Translation and grammatical notes for self-study(Books by Goyal Publishers Available in shops / Online) **3.** Nihongo Challenge – Kanji(Available with Japanese Language schools/teachers)		
Reference Books:		
1. Nihongo Shoho: For better understanding and practice of Basic Japanese Grammar **2.** Marugoto : For scenario based Japanese conversation practice		

Savitribai Phule Pune University, Pune
Third Year of Artificial Intelligence and Machine Learning (2020 Course)
Mandatory Audit Course 4
318560(D)- MOOC- Learn New skills

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Practical (PR) : 1 hrs/week	**Non Credit**	**Audit Course**

Prerequisites: Basic Knowledge of computer and Programming Skills

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

Course Outcomes :

On completion of the course, learner will acquire additional knowledge and skill.

About the Course

MOOCs (Massive Open Online Courses) provide affordable and flexible way to learn new skills, pursue lifelong interests and deliver quality educational experiences at scale. Whether you're interested in learning for yourself, advancing your career or leveraging online courses to educate your workforce, SWYAM, NPTEL, edx or similar ones can help. World's largest SWAYAM MOOCs, a new paradigm of education for anyone, anywhere, anytime, as per your convenience, aimed to provide digital education free of cost and to facilitate hosting of all the interactive courses prepared by the best more than 1000 specially chosen faculty and teachers in the country. SWAYAM MOOCs enhances active learning for improving lifelong learning skills by providing easy access to global resources. SWAYAM is a programme initiated by Government of India and designed to achieve the three cardinal principles of Education Policy viz., access, equity and quality. The objective of this effort is to take the best teaching learning resources to all, including the most disadvantaged. SWAYAM seeks to bridge the digital divide for students who have hitherto remained untouched by the digital revolution and have not been able to join the mainstream of the knowledge economy. In order to ensure that best quality content is produced and delivered, nine National Coordinators have been appointed. Out of these nine National Coordinators, NPTEL (National Programme on Technology Enhanced Learning) is for Engineering

Guidelines for Instructor's

- Instructor/mentor is requested to promote students to opt for courses with proper mentoring.
- Instructor/Mentor who teach the course or in relevant discipline can be a mentor .Should enroll to the course
- Instructor/Mentor can only choose up to 2 courses.
- One mentor for every 50 to 60 students.
- Instructor/Mentors can see the assignment scores of mentees
- Instructor/Mentors can help with explaining gaps in taught concepts.
- Instructor/Mentors can give more practice assignments
- The departments will take care of providing necessary infrastructural facilities and other facilities for the learners.

Guidelines for Student's

- Students have to select the mentor on the portal

- NPTEL is offering the online courses with a timeline of 4, 8 or 12-weeks through an online portal.
- SPPU Student has to take 12 weeks course for 3 credits.
- Each week, you need to watch 3 to 6 video lectures (of length 20 to 30 minutes) and attempt one online Assignment quiz at your convenient time and submit with in a deadline. Also submit the same assignments to the mentor as a part of journal. This is **mandatory** for all the students who opted mandatory audit course 3 as MOOC-Learn new skills.
- The enrolment to and learning from these courses involves no cost watch video lectures and attempt. Assignment online quizzes.
- After 2-3 weeks of starting of the course, an option of Registration for Final Exam with the fees of Rs. 1000/1100 will be given. If you're confident enough, you can proceed to the Exam Registration. This is **optional** for students.
- If the student wish to opt an option of registration for final exam then E-certificate from organizing IIT/IISc will be given to the successful candidates of the Final score=25% assignment score (online) + 75% exam (offline) score. To be eligible for a certificate, the learner should have scored >=40% final score.
- E-verifiable certificates are made available on nptel.ac.in
- NPTEL conduct final (proctored) exam at different exam centers all over India.
- After completion of the exam, student must submit the E-certificate to the college/department.

References

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