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
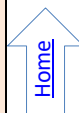
Savitribai Phule Pune University, Pune
Third Year of Artificial Intelligence and Machine Learning (2020 Course)
318542: IoT with Artificial Intelligence

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.

Home

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		
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

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

Home

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		
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)

Home

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: **Practical (PR) : 2 hrs/week**	**Credit Scheme:** **01 Credit**	**Examination Scheme:** **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
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 visualizations, mathematical model, Test data set and comparative/complexity analysis (as applicable). Batch size for practical and tutorials may be as per guidelines of authority

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/

Home

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