Maharishi DayanandUniversity, Rohtak
SCHEME OF STUDIES AND EXAMINATION

B.Tech (Artificial Intelligence & Machine Learning)
B.Tech (Computer Science and Engineering-Artificial Intelligence & Machine Learning)
4th Year

Semester: 7th&8th
Scheme effective from 2023-24

COURSE CODE ANDDEFINITIONS

Course Code	Definitions
L	Lecture
T	Tutorial
P	Practical
BSC	Basic Science Courses
ESC	EngineeringScienceCourses
HSMC	Humanities and Social Sciences includingManagementcourses
PCC	Professional Core Courses
PEC	Professional Elective Courses
LC	Laboratory Courses
MC	Mandatory Courses
PT	Practical Training
S	Seminar

Maharishi Dayanand University Rohtak
B.Tech. (Artificial Intelligence & Machine Learning)
B.Tech. (Computer Science and Engineering- Artificial Intelligence & Machine Learning)
Scheme of Studies/Examination w.e.f. 2023-24
Semester-7

Sr. No	Course Code	Course Title	Hours per week			Total Contact Hrs. per week	Credit	Examination Schedule (Marks)				Duration of Exam (Hours)
			L	T	P			Internal Assessment	Theory	Practical	Total	
1.	PCC-AI-401G	Deep Learning	3	0	0	3	3	25	75		100	3
2.	PCC-AI-403G	Applied Machine Learning	3	0	0	3	3	25	75		100	3
3.	Refer to Annexure-II	Professional Elective-IV	3	0	0	3	3	25	75		100	3
4.	Refer to Annexure-III	Open Elective-I	3	0	0	3	3	25	75	-	100	3
5	LC-AI-441G	Project-II	0	0	4	4	2	50	-	50	100	3
6.	LC-AI-443G	Deep Learning Lab	0	0	2	2	1	25	-	25	50	3
7.	LC-AI-445G	Artificial Programming Lab-III	0	0	2	2	1	25	-	25	50	3
8.	LC-AI-447G	Seminar/MOOC	0	0	2	2	1	25	-	25	50	3
9.	MC-319G*	Business Basics for Entrepreneurs	2	0	0	2	0	-	-	-	-	-
10.	PT-CSE-425G (Common with CSE)	Practical Training -II	0	0	2	2	0	-	-	-	-	-
Total			14		12	26	17				650	

*__MC-319G__ is a mandatory non –credit course based on Business Basics for Entrepreneurs experts sessions in which the students will be evaluated as per their performance of learning and required toget passing Grade as per below.

PT-CSE-425G Practical Training II: The evaluation of Practical Training-II will be based on seminar, viva-voce, report submitted by the students.

According to performance, the students will be awarded grades A,B,C,F; A student who is awarded 'F' grade is required to repeat the above courses (MC-319G & PT-CSE-425G)

Grades : Excellent: A, Good : B, Satisfactory: C, Not Satisfactory: F

Maharishi Dayanand University Rohtak
B.Tech. (Artificial Intelligence & Machine Learning)
B.Tech. (Computer Science and Engineering- Artificial Intelligence & Machine Learning)
Scheme of Studies/Examination w.e.f. 2023-24
Semester-8

Sr. No	Course Code	Course Title	Hours per week			Total Contact Hrs. / week	Credit	Examination Schedule (Marks)				Duration of Exam (Hrs)
			L	T	P			Internal Assessment	Theory	Practical	Total	
1	PCC-CSE-402G	Software Engineering & Project Management	3	0	0	3	3	25	75	-	100	3
2	Refer to Annexure-II	Professional Elective-V	3	0	0	3	3	25	75	-	100	3
3.	Refer to Annexure-II	Professional Elective-VI	3	0	0	3	3	25	75	-	100	3
3	Refer to Annexure-II	Professional Elective-VII	3	0	0	3	3	25	75	-	100	3
4	Refer to Annexure-III	Open Elective-II	3	0	0	3	3	25	75	-	100	3
5	LC-AI-442G	Project-III	0	0	4	4	2	50	-	50	100	3
7	LC-AI-444G	Artificial Programming Lab-IV	0	0	2	2	1	25	-	25	50	3
8	MC-320G*	Entrepreneurship Management	0	0	2	2	0	-	-	-	-	-
Total			14	0	8	22	18	200	375	75	650	-

*__MC-320G__ is a mandatory non –credit course based on Entrepreneurship Management experts sessions in which the students will be evaluated as per their performance of learning and required toget passing Grade as per below.

Accordingtoperformance,thestudentswill beawardedgradesA,B,C,F; Astudent whoisawarded‘F’gradeisrequiredtorepeat the above courses (MC-319G & PT-CSE-425G)

Grades : Excellent: A, Good : B, Satisfactory: C, Not Satisfactory: F

Annexure-II

Professional Elective Courses

(Choose Professional Elective Courses)

	Professional Electives	
	Course Code	**Course title**
Professional Elective -IV	PEC-DS-405G	Advanced Python Programming
	PEC-AI-405G	Reinforcement Learning
	PEC-AI-418G	Web Intelligence
Professional Elective – V-VII (Any 3 Subjects)	PEC-AI-404G	Social Network Analysis
	PEC-AI-406G	Recommender Systems
	PEC-AI-407G	Computer Vision& Pattern Recognition
	PEC-AI-408G	Decision Support and Intelligent System
	PEC-AI-409G	AIML Applications in IoT
	PEC-AI-410G	Intelligent Robots and Drone Technology
	PEC-AI-411G	Artificial Intelligence for Cyber security
	PEC-AI-412G	Machine Learning for Medical Image Analysis
	PEC-AI-413G	AI in Healthcare
	PEC-AI-414G	Speech and Language Processing using Deep Learning
	PEC-DS-406G	Image and Video Analytics
	PEC-AI-415G	Intelligent Information Retrieval

Annexure-III

Open Elective Courses

(Choose any 2Open Elective Courses)

Sr. No.	Course Code	Course title
	OEC-DS-431G	Open Source Programming
	OEC-AI-431G	Data Visualization and Tableau
	OEC-DS-432G	Information Storage and Management
	OEC-DS-433G	Virtualization
	OEC-AI-434G	R Programming
	OEC-AI-436G	Essentials of Hadoop
	OEC-ME-451G	Intelligent Vehicle Technology
	OEC-ME-452G	Hybrid and Electrical Vehicle
	OEC-DS-434G	Data Analysis using Open Source Tools

Deep Learning					
Course code	PCC-AI-401G				
Category	Professional Core Course				
Course title	Deep Learning				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

COURSE OBJECTIVES:

1. Understand the concepts of Neural Networks and Deep Learning
2. Understand Deep neural network and layered learning approach
3. Study and understand CNN and RNN for deep learning
4. Learn and understand Auto Encoders and its applications
5. Understand concept of transfer learning and its applications with keras

Unit-I

Introduction: Feed forward Neural networks, Gradient descent and the back propagation algorithm, Unit saturation, the vanishing gradient problem, and ways to mitigate it. RelU Heuristics for avoiding bad localminima, Heuristics for faster training, Nestors accelerated gradient descent, Regularization, Dropout.Convolutional Neural Networks: Architectures, convolution / pooling layers, normalization, sequence modeling, applications.

Unit-II

Recurrent NeuralNetworks: LSTM, GRU, Encoder Decoder architectures. Introduction to Simple DNN Platform for Deep Learning ,Deep Learning Software Libraries,Deep Unsupervised Learning: Autoencoders,Variational Auto-encoders, Adversarial Generative Networks, Auto-encoder and DBM Attention andmemory models. Dynamic memory networks.

Unit-III

Applications of Deep Learning to ComputerVision: Image segmentation, object detection, automatic image captioning, Image generation withGenerative adversarial networks, video to text with LSTM models, Attention models for computer visiontasks.

Applications of Deep Learning to NLP: Introduction to NLP and Vector Space Model ofSemantics,

Word Vector Representations: Continuous Skip-Gram Model, Continuous Bag-of-Wordsmodel (CBOW), Glove, Evaluations.

Unit-IV

Applications in word similarity, Analogy reasoning: Named EntityRecognition, Opinion Mining using Recurrent Neural Networks: Parsing and Sentiment Analysis usingRecursive Neural Networks: **Sentence Classification using Convolutional Neural Networks**: DialogueGeneration with LSTMs, Applications of

Dynamic Memory Networks in NLP, Factoid Question Answering,similar question detection, Dialogue topic tracking, Neural Summarization.

Suggested References Books:

1. I. Goodfellow, Y. Bengio and A. Courville *Deep Learning(1e),* MIT Press,2016.
2. T. Hastie, R. Tibshirani, and J. Friedman *The Elements of Statistical Learning(2e),* Springer,2013.
3. D. Koller, and N. Friedman *Probabilistic Graphical Models*, MIT Press,2010.
4. S. Haykin, *Neural Networks and Learning Machines,* PHI, 2016.
5. Ng's Notes on *Machine Learning*
6. JasonBrownlee,"Deep Learning with Python", ebook,2016.

Course outcomes:

1. Apply basic mathematical concepts in Deep Learning
2. Work with powerful framework for supervised learning
3. Deal with Convolution Neural Networks
4. Analyze various types efficient data encoders
5. Apply various network models in deep learning

Applied Machine Learning				
Course code	PCC-AI-403G			
Category	Professional Core Course			
Course title	Applied Machine Learning			
Scheme and Credits	L	T	P	Credits
	3	0	0	3
Class work	25 Marks			
Exam	75 Marks			
Total	100 Marks			
Duration of Exam	03 Hours			

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Objectives of the course:

The objective of this course are:

1. Analyze the text data using Machine Learning
2. Analyze the audio data using Machine Learning
3. Analyze Time series and Sequential data using Machine Learning
4. Analyze the Image Content using Machine Learning
5. Visualize the data

Unit-I

Text Feature Engineering-Introduction, Cleaning text data, Preprocessing data using, tokenization , tagging and categorising words, Sequential tagging, Backoff tagging, Creating features from text data-
Stemming,Lemmatising, Bagging using random forests, Implementing bag of words, Testing prepared dataAnalyze the results, Building a text classifier, Analyzing the sentiment of a sentence, Implement the sentiment analysis ofa sentence, Identifying patterns in text using topicmodeling, Implement identifying patterns in text using topic modeling, Case study- Twitter Data ;
Speech Recognition- Introduction, Reading audio data, Plotting audio data, Transforming audio signals into the frequency domain, Apply Fourier transform signal and plot, Generating audio signals with customparameters, Generate the time axis,

Unit-II

Speech Recognition- Synthesizing music, Construct the audio sample -amplitudeand frequency, synthesizer function, Extracting frequency domain features, MFCC and filter bank features, Building Hidden Markov Models, HMM training and prediction, Building a speech recognizer, MFCC features, Case study.
Dissecting Time Series and SequentialData – Introduction, Transforming data into the time series format, Pandas and Numpy to convert Time Series data, Plotting time series data, Slicing time series data, Operating on time series data, Plotting sliced time series data, Operating on time series data, Extracting statistics from time seriesdata, Correlation coefficients, Plotting and understanding correlations, Building Hidden Markov Models forsequential data, Prepare the Time Series data, Train Gaussian HMM, Visualizing the model, Building Conditional Random Fields forsequential text data, CRF Model, Analyzing stock market data using, Hidden Markov Models, Train the HMM and visualize

Unit-III

Image Content Analysis, Computer Vision, Operating on images using OpenCV-Python, Learn to extract and load the image, Detecting edges, Histogram equalization, Sobel filter, Laplacian edge detector, Canny edge detector, Histogram equalization, Visualize gray scale image, Detecting corners, Understand the output corner detection image, Detecting SIFT feature points, SIFT feature detection, Visualize the feature detected image, Building a Star feature detector, Detect features using the Star featuredetector, Visualize keypoints on the input image, Creating features using visual codebookand vector quantization, Method to quantize the data points

Unit-IV

Biometric Face Recognition - Face detection from the image and video, Capturing and processing video from awebcam, Resizing and Scaling, Building a face detector using Haarcascades , determine the location of a face in thevideo frames captured from the webcam, Face detector on the grayscale image, Building eye and nose detectors, Face cascade classifier, Visualize eye and nose detector , Performing Principal ComponentsAnalysis, PCA in face recognition systems, Convert the dataset from a five-dimensional set to a two-dimensionalset , Kernel Principal Components Analysis , Plot Kernel PCA-transformed data, Performing blind source separation, Independent Components Analysis, Perform Kernel PCA, Plot the PCA-transformed data

References Books:

1. Prateek Joshiandco, Python: Real World Machine Learning, Packt Publishing,2016
2. Sebastian Raschka, Python Machine Learning, Packt Publishing, 2013.
3. Richert Coelho, Building Machine Learning Systems with Python, Packt Publishing,2016
4. MichaelBowles,MachineLearninginPython,Wiley&Sons,2015

Course Outcomes:

After successfully completing the course the student should be able to

1. Identifying patterns in text using topic modeling
2. Building a speech recognizer
3. Extracting statistics from time series data,
4. Building Conditional Random Fields for sequential text data
5. Building an object recognizer

Project-II

Coursecode	LC-AI-441G				
Category	Laboratory Courses				
Course title	Project-II				
Schemeand Credits	L	T	P	Credits	
	0	0	4	2	
Class work	50 Marks				
Exam	50Marks				
Total	100Marks				
Durationof Exam	03Hours				

Course Objectives:

1. To prepare the student to gain major design and or research experience as applicable to the profession
2. Apply knowledge and skills acquired through earlier course work in the chosen project.
3. Make conversant with the codes, standards, application software and equipment
4. Carry out the projects within multiple design constraints
5. Incorporate multidisciplinary components
6. Acquire the skills of comprehensive report writing

Students will be assigned projects(Applications/Research based) individually or in a group of not more than 3 students depending on the efforts required for completion of project in the subject(s)/area/ skills delivered in this semester using current tools/technology(ies).

The project will have 4 stages:
(*Marks for internal evaluation are given in brackets)

1. Synopsis submission (10marks),
2. 1st mid-term progress evaluation(Literature Survey in case of research project) (10 marks)
3. 2nd mid-term progress evaluation (Paper Publishing/acceptance in a reputed Journal or Conference acceptance/ Presenting) (10 marks)
4. Final submission evaluation (20 marks).

The external examiner will evaluate the project on the basis of idea/quality of project, implementation of the project, project report and/or publication and viva.

Course Outcomes:

Design a system / process or gain research insight into a defined problem as would be encountered in engineering practice taking into consideration its impacton global, economic, environmental and social context.

Deep Learning Lab

Course code	LC-AI-443G			
Category	Laboratory Course			
Course title	Deep Learning Lab			
Scheme and Credits	L	T	P	Credits
	0	0	2	1
Class work	25 Marks			
Exam	25 Marks			
Total	50 Marks			
Duration of Exam	03 Hours			

NOTE:

1. **Lab programs/activities can be designed and developed by the subject faculty using Python, Python Library/suitable Open Source tools/ software.**
2. **A min 15 Lab activities will be carried out from the offered coursecontentsofDeep Learning in the semester.**

In this course, various experiments will be performed, covering various Deep Learning techniques.Experiments covering various deep learning techniques for computer vision, NLP, word vector representations,word similarity, Analogy reasoning, sentence classifications, questions answering, handwritten digits recognitions, sentiment analysis using Keras/Tensor Flow etc.

Artificial Programming Lab-III	
Course code	LC-AI-445G

Category	Laboratory Course				
Course title	Artificial Programming Lab-III				
Scheme and Credits	L	T	P	Credits	
	0	0	2	1	
Branches (B. Tech.)	Computer Science and Engineering				
Class work	25 Marks				
Exam	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

NOTE:

A min 15Lab activities relatedto the coursecontentsofProfessional Electives (PE-IV and PE-V) can be designed and developed by the subject faculty using suitable Python or any available Open Source tools/ software.

Seminar/MOOC					
Course code	LC-AI-447G				
Category	Laboratory Course				
Course title	Seminar/MOOCs				
Scheme and Credits	L	T	P	Credits	
	0	0	2	1	
Class work*	25 Marks				
Exam	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

Course Objectives:

The purpose of learning this course is to:

1. Identify an area of interest within the program or a related one (multidisciplinary), carry out a literature survey on it, gain understanding and present the same before an audience. OR
2. Identify a MOOC of interest within the program or a related one (multidisciplinary) available at the MOOCs Platform, registered themselves and earned the certification.

Students have to choose either a seminar or MOOC enrollment.

1. For seminar, Students have to identify a topic/area of interest within the program or a related one (multidisciplinary), carry out a literature survey on it, gain understanding, publish a literature survey paper in a reputed journal / conference/proceeding and present the same work before an audience of the department. Students may do it either individually or in a group of not more than 2 students depending on the efforts required for completion of seminar.
2. In case of MOOC, one(individually)has to Identify a MOOCCourse of interest within the program or a related one (multidisciplinary) available at the MOOCs Platform, registered themselves,gain understanding and earned the certification by qualify the evaluation process.

The Evaluation of this course will have 4 stages:
(*Marks for internal evaluation are given in brackets)

1. Synopsis submission of Seminar/ MOOC identification and registration (5 marks)
2. 1st mid-term progress evaluation (Literature Survey/MOOCs Learning Stage) (5 marks)
3. 2nd mid-term progress evaluation- (5 marks)
   1. Paper Publishing/acceptance or Conference acceptance/ Presenting OR
   2. MOOCs Learning Last Stage
4. Final Presentation evaluation (10 marks).

The external examiner will evaluate the Seminar/MOOC on the basis of idea/quality of literature survey, paper publish/presentation of the topic/MOOC certification or subsequent stage, seminar/MOOC course report and viva.

Course Outcomes:

At the end of this course, learners will be able to:

1. Carry out a self-study of an area of interest and communicate the same to others with clarity

Practical Training-II					
Course code	LC-CSE-G				
Category	Laboratory Course				
Course title	Practical Training-II				
Scheme and Credits	L	T	P	Credits	**Remarks-** Common with CSE
	0	0	0	0	
Class work	-				
Exam	-				
Total	-				
Duration of Exam	-				

The evaluation of Practical Training-I will be based on seminar, viva-voce, report submitted by the students. According to performance, the students are awarded grades A, B, C, F. A student who is awarded 'F' grade is required to repeat Practical Training.

Grades :

Excellent: A

Good : B

Satisfactory: C

Not Satisfactory: F

Software Engineering & Project Management					
Course code	PCC-AI-402G				
Category	Professional Core Course				
Coursetitle	Software Engineering & Project Management				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

COURSE OBJECTIVES:

1. Familiarize the software life cycle models and software development process
2. Understand the various techniques for requirements, planning and managing a technology project
3. Examine basic methodologies for software design, development, testing, closure and implementation
4. Understand manage users expectations and the software development team
5. Acquire the latest industry knowledge, tools and comply to the latest global standards for project management

Detailed Syllabus:

Unit-I

Introduction to Software Engineering ,Software Project Management – life cycle activities, Traditional – Waterfall, V Model, Prototype, Spiral, RAD, Conventional – Agile, XP, Scrum, Sample for Identify the Software Project, Create Business Case, Arrive at a ProblemStatement.

Introduction to Requirement Engineering , Requirements Elicitation , Software Project Effort and cost estimation, Cost estimation, Cocomo 1 and 2 , Risk Management, Configuration management**,** Project Planning – WBC, planning, scope, risk

Unit-II

Software Design – Software Design, FundamentalsDesign Standards – Design Type , Design model – Architectural design,Software architecture Software Design Methods, Top Down , Bottom Up, Module Division (Refactoring) , Module Coupling , Component level design, User Interface Design, Pattern oriented design, Web application design,

Unit-III

Software Construction, Coding Standards, Coding Framework Reviews – Desk checks (Peer Reviews), Walkthroughs, Code Reviews, Inspections, Sample of State and Sequence Diagram,Deployment Diagram, Sample FrontendDesign (UI/UX); Coding Methods , Structured Programming, Object- Oriented Programming, Automatic Code Generation, Sample for :Module Description, Module implementation (phase 1) Using Agile, Software Code Reuse , Pair Programming, Test-Driven Development, ConfigurationManagement, Software Construction Artifacts,

Unit-IV

Introduction to testing, Verification, Validation Test Strategy, Planning, Example: Test Strategy and Planning, Demo for: Module Implementation (Phase 2),Scrum Master to Induce New Issues in Agile Development; Test Project Monitoring and Control, Design –Master test plan, types, Test Case Management, Test Case Reporting, Product Release, Product Release Management, Implementation, User Training, Maintenance -Introduction,

Maintenance Types – Corrective, Adaptive, Perfective, Preventive, User Manual, Analysis of Costing, Effort and Resources, Maintenance Cost, Maintenance Process life cycle, Software Release, Software maintenance

Suggested Reference Books:

1. Roger S. Pressman, Software Engineering – A Practitioner Approach, 6th ed., McGraw Hill, 2005
2. Ian Sommerville, Software Engineering, 8th ed., Pearson Education, 2010
3. Rajib Mall, Fundamentals of Software Engineering, 4thed., PHI Learning Private Limited, 2014
4. Ramesh, Gopalaswamy, Managing Global Projects, Tata McGraw Hill, 2005
5. Ashfaque Ahmed, Software Project Management: a process-driven approach, Boca Raton, Fla: CRC Press, 2012
6. Walker Royce, Software Project Management, Pearson Education, 1999
7. Jim Smith Agile Project Management: Creating Innovative Products, Pearson 2008

COURSE OUTCOMES (Cos):

1. Identify the process of project life cycle model and process
2. Analyze and specify software requirements through a productive working Relationship with project stakeholders
3. Design the system based on Functional Oriented and Object Oriented Approach for Software Design.
4. Develop the correct and robust code for the software products
5. Perform by applying the test plan and various testing techniques

Project-III					
Coursecode	LC-AI-442G				
Category	Laboratory Courses				
Course title	Project-III				
Schemeand Credits	L	T	P	Credits	
	0	0	4	2	
Class work	50 Marks				
Exam	50Marks				
Total	100Marks				
Durationof Exam	03Hours				

Course Objectives:

1. To prepare the student to gain major design and or research experience as applicable to the profession
2. Apply knowledge and skills acquired through earlier course work in the chosen project.
3. Make conversant with the codes, standards, application software and equipment
4. Carry out the projects within multiple design constraints
5. Incorporate multidisciplinary components
6. Acquire the skills of comprehensive report writing

Students will be assigned projects(Applications/Research based) individually or in a group of not more than 3 students depending on the efforts required for completion of project in the subject(s)/area/ skills delivered in this semester using current tools/technology(ies).

The project will have 4 stages:
(*Marks for internal evaluation are given in brackets)

1. Synopsis submission (10marks),
2. 1st mid-term progress evaluation (Literature Survey in case of research project) (10 marks)
3. 2nd mid-term progress evaluation (Paper Publishing/acceptance in a reputed Journal or Conference acceptance/ Presenting) (10 marks)
4. Final submission evaluation (20 marks).

The external examiner will evaluate the project on the basis of idea/quality of project, implementation of the project, project report and/or publication and viva.

Course Outcomes:

Design a system / process or gain research insight into a defined problem as would be encountered in engineering practice taking into consideration its impacton global, economic, environmental and social context.

Advanced Programming Lab-IV					
Course code	LC-AI-444G				
Category	Laboratory Course				
Course title	Advanced Programming Lab-IV				
Scheme and Credits	L	T	P	Credits	
	0	0	2	1	
Class work	25 Marks				
Exam	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

NOTE:

1. **Lab programs/activities can be designed and developed by the subject faculty using Python or any suitable OpenSource tools/ software.**
2. **Min 25 Lab activities will be carried out from the offered coursecontentsofProfessional Electives(PE-V, PE-VI & PE-VII) in the semester.**
3. **Case studies may be given from the courses to implement using current course(s) skills/technology(ies).**

Professional Electives

Advanced Python Programming				
Course code	PEC-DS-405G			
Category	Professional Elective Course			
Course title	Advanced Python Programming			
Scheme and Credits	L	T	P	Credits
	3	0	0	3
Class work	25 Marks			
Exam	75 Marks			
Total	100 Marks			
Duration of Exam	03 Hours			

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Objectives of the course:

The objective of this course are:

1.To be able to apply advanced python programming concepts for industry standard problems.
2.To perform advanced Data Preprocessing tasks like Data Merging and Mugging
3.To be able to develop powerful Web-Apps using Python

Detailed Course

Unit-I

Data Structures: Problem solving using Python Data Structures : LIST, DICT, TUPLES and SET- Functions and Exceptions – Lamda Functions and Parallel processing – MAPS – Filtering - Itertools – Generators.
Classes & Objects: Classes as User Defined Data Type ,Objects as Instances of Classes, Creating Class and Objects, Creating Objects By Passing Values, Variables & Methods in a Class Data , Abstraction, Data Hiding, Encapsulation, Modularity, Inheritance, Polymorphism

Unit-II

Python Multithreading: Python Multithreading and Multiprocessing Multithreading and multiprocessing Basics – Threading module and example – Python multithreading - Multithreaded Priority Queue.
Data Processing: Handling CSV, Excel and JSON data - Creating NumPy arrays, Indexing and slicing in NumPy, Downloading and parsing data, Creating multidimensional arrays, NumPy Data types, Array Attribute, Indexing and Slicing, Creating array views copies, Manipulating array shapes I/O – MATPLOT LIB

Unit-III

Data Science Perspectives: Using multilevel series, Series and Data Frames, Grouping, aggregating, Merge Data Frames, Generate summary tables, Group data into logical pieces, Manipulate dates, Creating metrics for analysis.
Data Handling Techniques: Data wrangling, Merging and joining, - Loan Prediction Problem, Data Mugging using Pandas

Unit-IV

Web Applications: Web Applications With Python – Django / Flask / Web2Py – Database Programming – NoSQL databases - Embedded Application using IOT Devices - Building a Predictive Model for IOT and Web programming; Recent Trends and Contemporary issues.

References Books:

1. Doug Farrell, The Well Grounded Python Developer; Manning Publications, 2021
2. Paul Barry, Head-First Python, O-Reilly Media, 2016
3. Zed A Shaw, Learn Python the Hard Way - A Very Simple Introduction to the Terrifyingly Beautiful World of Computers and Code, Addison Wesley Press, 2013
4. Eric Mathews, Python Crash Course, Second Edition, No Starch Press, 2019
5. Michael Kennedy, Talk Python: Building Data-Driven Web Apps with Flask and SQLAlchemy, Manning Publications, 2020

Course Outcomes:

After successfully completing the course the student should be able to

1. Understand the nuances of Data Structures
2. Derive an understanding of a classes and objects and their potential
3. Gain knowledge of multithreading concepts and implementing the same
4. Appreciate the difference between different data processing techniques
5. Learn to apply Python features for Data Science
6. Get an insight into Metrics Analysis
7. Develop web-apps and build models for IoT

Reinforcement Learning	
Course code	PEC-AI-405G
Category	Professional Elective Course

Course title	Reinforcement Learning			
Scheme and Credits	L	T	P	Credits
	3	0	0	3
Class work	25 Marks			
Exam	75 Marks			
Total	100 Marks			
Duration of Exam	03 Hours			

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Objectives of the course:

The objective of this course are:

1. To understand the main concepts related to reinforcement learning
2. To review real-world applications of reinforcement learning
3. To apply reinforcement learning to solve real-life problems

Unit-I

Introduction: Origin and history of Reinforcement Learning research. Its connections with other relatedfields and with different branches of machine learning. **Markov Decision Process:** Introduction to RLterminology, Markov property, Markov chains, Markov reward process (MRP), Introduction to Markovdecision process (MDP), state and action value functions.

Unit-II

Prediction and Control byDynamic Programming: Overview of dynamic programming forMDP, definition and formulation ofplanning in MDPs, principle of optimality, iterative policy evaluation, policy iteration, value iteration, Banachfixed point theorem, proof of contraction mapping property of Bellman expectation and optimality operators,proof of convergence of policy evaluation and value iteration algorithms, DP extensions.

Unit-III

Monte CarloMethods for Model Free Prediction and Control: Overview of Monte Carlo methods for model free RL,First visit and every visit Monte Carlo, Monte Carlo control, On policy and off policy learning, Importancesampling. **TD Methods:** Incremental Monte Carlo Methods for Model Free Prediction, Overview TD (0), TD(1) and TD(λ), k-step estimators, unified view of DP, MC and TD evaluation methods, Q-Learning, and theirvariants.

Unit-IV

Function Approximation Methods and Deep Reinforcement Learning: Revisiting risk minimization, gradient descent from MachineLearning, Gradient MC and Semi-gradient TD (0) algorithms, Eligibility trace

for functionapproximation, after states, Control with function approximation, Least squares, Experience replay in deepQ-Networks; Policy Gradients.Introduction to Deep Learning, Deep Q-Learning, Value-based Deep RL: Deep Q-network, Policy-based Deep RL: REINFORCE, Asynchronous Methods for Deep RL: Advantage Actor-Critic (A2C), Model-based Deep RL, Contemporary Issues

References Books:

1. R.S. Sutton and A.G. Barto, Reinforcement Learning: An Introduction(2e), A Bradford Book, 2018
2. M. Lapan, Deep Reinforcement Learning Hands-On: Apply modern RL methods to practical problems of chatbots, robotics, discrete optimization, web automation(2e), Expert Insight,2020.
3. D. Bertsekas, Reinforcement Learning and Optimal Control(1e), Athena Scientific, 2019.
4. Reinforcement Learning: An Introduction (Adaptive Computation and Machine Learning series) 2nd edition, Richard S. Sutton and Andrew G. Barto, A Bradford Book; 2018, ISBN 978-0262039246

Course Outcomes:

After successfully completing the course the student should be able to

1. Define the key features of reinforcement learning (RL) that distinguishes it from AI and non-interactive machine learning
2. Decide if an application problem should be formulated as a RL problem and state what algorithm is best suited for addressing it
3. Describe and implement in code common RL algorithms

Web Intelligence	
Course code	PEC-AI-418G
Category	Professional Elective Course
Course title	Web Intelligence

Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Objectives of the course:

The objective of this course are:

1. Understand the topics of Web Intelligence
2. Study models of information retrieval, semantic webs, search engines, and web mining.
3. Gain knowledge on the algorithmic aspect of Web Intelligent systems
4. Acquire knowledge on Data mining techniques
5. Understand the impact of Social Network Design for Web Intelligence
6. Gain Knowledge on different approaches required for studying the impact of social network for Web Intelligence

Detailed Course

Unit-I

Introduction to Web Intelligence, What is Web Intelligence?, Benefits of Intelligent Web:Whatapplications can benefit from web intelligence, Wisdom Web, Ingredients of Intelligent Web, Topics of Web Intelligence, How can I build intelligence in my own application?, Examples of intelligent web applications, Fallacies of Intelligent applications, Related Technologies

Unit-II

Information Retrieval-Introduction, Document Representation, Retrieval Models, Evaluation of Retrieval Performance, Semantic Web-Introduction, The Layered-Language Model, Metadata and Ontologies, Ontology Languages for the Web, Tool Environment for the Ontology, RDFferret-Full Text Search and RDF Querying, Onto Share-Community support, Onto Edit-Ontology Development, OntoView-Change Management for Ontologies, Sesame-Repositories for Ontologies andData, CORPORIUM- Information Extraction

Unit-III

Data Mining Techniques-Classification, Clustering andAssociation, Associations, Web Usage Mining- Web-Log processing, Web Usage Mining -Analyzing Web Logs, Applications of Web Usage Mining, Clustering of Web Users, Applications of Web Usage Mining-Classification Modeling of Web Users, Applications of Web Usage Mining-Association Mining of Web Usages, Sequence-Pattern Analysis of Web Logs;
Web Content Mining- Introduction, Web Crawlers, Search Engines, Personalization of Web Content, Multimedia Information Retrieval, Web Structure Mining- Modeling WebTopology, PageRank Algorithm, Hyperlink-Induced Topic Search (HITS), Random Walks on the Web;

Unit-IV

Social Network Design for WebIntelligence: Introduction, Web Intelligence , Overview of Social Intelligence Design: The Travelling Conversation Model, A Broadcast-Based Approach, AConversational Agent-Based Approach, Smart Environment based approach, Psychological Evaluation, TechnicalIssues, Groups and Communities, Issues ofSocial Intelligence Design, Applications ofSocial Intelligence Design, Case Study-Putting it all together : anintelligent news portal, Applying Web Intelligence for Business Intelligence

References Books:

1. Akerkar, R. &Lingras, P. (2008). Building an Intelligent Web: Theory and practice. Jones and Bartlett Publishers, Sudbury, Massachusetts. ISBN-13: 978-0-7637-4137-2
2. Marmanis&Babenko: Algorithms of the Intelligent Web, Manning Publications, 2009, ISBN:978-1933988665
3. Witten, Ian H. & Frank, E. (2005). Data Mining: Practical Machine Learning Tools and Techniques. 2nd Edition, Morgan Kaufman. ISBN 0120884070, 9780120884070
4. Bing Liu: Web Data Mining, Springer, 2nd ed. 2011 (view online or download fromSpringerlink)
5. Manning, Raghavan and Schuetze: Introduction to Information Retrieval, CambridgeUniversityPress,2008(bookavailableonline)
6. N. Zhong, J.M. Liu, Y.Y. Yao, Web Intelligence (Springer, 2003)

Course Outcomes:

After successfully completing the course the student should be able to

1. Acquire the knowledge on topics and benefits of Web Intelligence
2. Acquire the ability to build models of information retrieval, semantic webs, search engines, and web mining.
3. Understand the basic ideas of Multimedia Information Retrieval
4. Acquire knowledge to use web crawlers and fetch relevant information
5. Acquire knowledge to refine the social network design approached used for developing intelligent web
6. Apply the knowledge of different web intelligence based algorithms in practical applications

Social Network Analysis						
Course code	PEC-AI-404G					
Category	Professional Elective Course					
Course title	Social Network Analysis					
Scheme and Credits	L	T	P	Credits		
	2	0	0	2		
Class work	25 Marks					
Exam	75 Marks					
Total	100 Marks					
Duration of Exam	03 Hours					

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

COURSE OBJECTIVES:

1. Understand the concepts of Social Web
2. Understand Network features Visualizing approach
3. Study and understand Link prediction
4. Learn and understand various analysis algorithms
5. Understand the concept of social influence and actions in marketing

Unit-I

Introduction to Social Web: Nodes, Edges and Network measures, Describing Nodes and Edges, Describing Networks, Layouts;

Unit-II

Visualizing Network features: The role of Tie Strength, Measuring TieStrength, Tie Strength and Network Structure, Tie Strength and Network Propagation, Link Prediction,Entity Resolution;
Link Prediction: Case Study Friend Recommendation, Introduction to CommunityDiscovery, Communities in Context, Quality Functions;

Unit-III

Algorithms: The Kernighan-Lin algorithm,Agglomerative Algorithms, Spectral Algorithms, Multi-level Graph Partitioning, Markov Clustering, OtherApproaches;

Unit-IV

Introduction to Social Influence: Influence Related Statistics, Social Similarity andInfluence, Homophile, Existential Test for Social Influence, Influence and Actions, Influence and Interaction,Influence Maximization in Viral Marketing

Suggested References Books:

1. S.P. Borgatti ,M.G. Everett , J.C. Johnson, *Analyzing Social Networks (2e*) SAGE Publications Ltd,2018
2. J. Goldbeck, *"Analyzing the Social Web",* Morgan Kaufmann Publications, 2013.
3. C. C. Aggarwal, "*Social Network Data Analytics*", Springer Publications, 2011.
4. J. Scott, *"Social Network Analysis", (3e),* SAGE Publications Limited, 2013.
5. S. Kumar, F. Morstatter and H. Liu, "*Twitter Data Analytics*", Springer Publications, 2013

Course outcomes: After successfully completing the course the student should be able to

1. Learn basic concepts in Social web
2. Work with Network features Visualizing approaches
3. Deal with Link predictions and recommendation systems
4. Analyze various types efficient network analysis algorithms
5. Learn social influence and related statistics in influence maximization

Recommender System

Course code	PEC-AI-406G				
Category	Professional Elective Course				
Course title	Recommender System				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Objectives of the course:

The objective of this course are:

1. To provide the students a foundation of recommender systems concepts
2. To expose the students to a variety of recommender systems algorithms
3. To provide the students a knowledge on the different evaluation methods of recommendersystems
4. To provide the students an ability to classify the different recommender systems solutions
5. To build up the capability to develop a recommender systems solution

Unit-I

Introduction: Recommender system functions, Linear Algebra notation: Matrix addition, Multiplication,transposition, and inverses; covariance matrices, Understanding ratings, Applications of recommendationsystems, Issues with recommender system.

Collaborative Filtering: User-basednearest neighbor recommendation, Item-based nearest neighbor recommendation, Model based and preprocessingbased approaches, Attacks on collaborative recommender systems.

Unit-II

Content-basedrecommendation: High level architecture of content-based systems, Advantages and drawbacksof content-based filtering, Item profiles, discovering features of documents, obtaining item features fromtags, representing item profiles, Methods for learning user profiles, Similarity based retrieval, Classificationalgorithms.

Knowledge based recommendation: Knowledge representation and reasoning, Constraintbased recommenders, Case based recommenders.

Hybrid approaches: Opportunities for hybridization,Monolithic hybridization design: Feature combination, Feature augmentation, Parallelized hybridizationdesign: Weighted, Switching, Mixed, Pipelined hybridization design: Cascade Meta-level, Limitations ofhybridization strategies.

Unit-III

Evaluating Recommender System: Introduction, General properties ofevaluation research, Evaluation designs, Evaluation on historical datasets, Error metrics, Decision-Supportmetrics, User-Centred metrics.
Context-Sensitive RecommenderSystems - The Multidimensional Approach -Contextual Pre-filtering: A Reduction-Based Approach - Post-Filtering Methods - Contextual Modeling
Time and Location sensitive Recommender System: Temporal Collaborative Filtering - Discrete Temporal Models - Location-Aware Recommender Systems
Social and Trust Centric Recommender System: Multidimensional Models for Social Context - Network-Centric and Trust-Centric Methods – UseInteraction in Social Recommenders

Unit-IV

Attack Resistant Recommender System: Understanding the Trade-Offs in Attack Models - Types of Attacks -Detecting Attacks on Recommender Systems - Strategies for Robust Recommender Design
Advanced Topics: Learning to Rank - Group Recommender Systems - Multi-Criteria Recommender - Active Learning in Recommender Systems - Privacy in Recommender Systems - Application Domains - Portal Content Personalization - Google News Personalization - Computational Advertising versus Recommender Systems; Recent trends and Contemporary Issues.

References Books:

1. C.C. Aggarwal , *Recommender Systems: The Textbook* (1e), Springer, 2016.
2. N Manouselis, H. Drachsler, K. Verbert and E. Duval., *Recommender Systems for Learning (1e)*,Springer 2013.
3. F. Ricci, L. Rokach, D. Shapira and B.P. Kantor, *Recommender Systems Handbook (1e)*,Springer ,2011.
4. K. Falk, Practical recommender systems. Shelter Island, NY: Manning Publications Company, 2019.(ISBN : 9781617292705)
5. D. Jannach, Recommender systems. New York: Cambridge University Press, 2011. (ISBN: 9780521493369)
6. D. Agarwal and B. Chung-Chen, Statistical methods for recommender systems. New York,NY: Cambridge University Press, 2016.(ISBN: 9781107036079)
7. R. Banik, Hands-On Recommendation Systems with Python. Birmingham, United Kingdom:PACKT Publishing Limited, 2018.(ISBN: 9781788993753)
8. S. Berkovsky, I.Cantador and D. Tikk, Collaborative Recommendations: Algorithms, Practical Challenges and Applications. UK: World Scientific Publishing Co, 2019.(ISBN:9789813275348)

Course Outcomes:

After successfully completing the course the student should be able to

1. Characterize different types of Recommender Systems, map a given real world problem to
2. appropriate model, understand and identify the stages and issues in the deployment of the system
3. Apply principles and techniques of recommender systems in applications related to recommender systems design and analysis
4. Analyze and evaluate various recommender algorithms
5. Implement appropriate recommender system for real world applications

Computer Vision and Pattern Recognition

Course code	PEC-AI-407G				
Category	Professional Elective Course				
Course title	Computer Vision and Pattern Recognition				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Objectives of the course:

The objective of this course are:

1. Recognize and describe both the theoretical and practical aspects of computing with images. Connect issues from Computer Vision to Human Vision
2. Describe the foundation of image formation and image analysis. Understand the basics of 2D and 3D Computer Vision.
3. Become familiar with the major technical approaches involved in computer vision. Describe various methods used for registration, alignment, and matching in images.
4. Get an exposure to advanced concepts leading to object and scene categorization from images.
5. Build computer vision applications.

Detailed Course

Unit-I

Introduction: Computer Vision-Definition and Overview, Image Formation,Geometric primitives, Lighting,Reflectance, Sampling and aliasing, Human Color Perception and Inference fromcolor, Image Transformation, 2D,3D Transformation, 3D to 2D Projection.

Image Processing: Point operation, Pixel transforms Color transforms Linear and Non-Linear Filtering,Transform Filtering Techniques, Interpolation and multi resolution.

Unit-II

Feature Detection and Matching: Feature detection, descriptor, matching, Feature tracking, Edge detection, Lines Detection, Edge linking, Successive approximationHough transform,Vanishing points, ObjectRecognition, Principal Component Analysis, SHIFT and HOG Feature.

Unit-III

Shape Detection andSegmentation: Active contours, Snakes, Dynamic snakes and CONDENSATION Scissors, Level Sets, Region Split and merge, Graph cut and Energy based methods,2D and 3D feature-based alignment, Pose estimation, Medical Image Segmentation.

Unit-IV

Motion Estimation: Triangulation, Two-frame structure from motion, Projective reconstruction, Self-calibration, Perspective and projective factorization, Bundle adjustment, Exploiting sparsity, Constrained structure and motion, Hierarchical motion estimation, Fourier-based alignment, Incremental refinement, Parametric Motion, Spline based motion, Optical Flow,Kalman Filtering, application of motion estimation to video stabilization, Medical Image Registration.

References Books:

1. R. Szeliski, *Computer Vision: Algorithms and Applications*, (2e), Springer International Publishing, 2021.
2. D. A. Forsyth and J. Ponce, *Computer Vision: A Modern Approach*, (2e), PHI learning 2012.
3. C. M. Bishop, *Pattern Recognition and Machine Learning*, (1e), Springer, 2011.
4. RichardSzeliski,"ComputerVision:AlgorithmsandApplications",Springer,2010.
5. Forsyth/Ponce,"ComputerVision:AModernApproach",PearsonEducationIndia;2ed(2015)
6. S.Nagabhushana,"ComputerVisionandImageProcessing",NewAgeInternationalPvtLtd; 1st ed(2005)
7. Rafael C. GonzaLez, "Digital Image Processing", Pearson Education; Fourth edition (2018)

Course Outcomes:

After successfully completing the course the student should be able to

1. Provide an introduction to computer vision including fundamentals of image formation
2. Provide a clear view of image formation
3. Provide a clear view of image processing Provide knowledge about Computational photography
4. Provide knowledge about Image rendering

Decision Support and Intelligent System					
Course code	PEC-AI-408G				
Category	Professional Elective Course				
Course title	Decision Support and Intelligent System				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Objectives of the course:

The objective of this course are:

1. Familiarize with Business Intelligence, Analytics and Decision Support
2. Understand the technologies for Decision making
3. Familiarize with predictive modeling techniques
4. Familiarize with sentiment analysis techniques
5. Understand about Multi-criteria Decision-making systems
6. Familiarize with Automated decision systems

Detailed Course

Unit-I

Information Systems Support forDecision Making, An Early Framework for ComputerizedDecision Support, The Concept of Decision SupportSystems, A Framework for Business Intelligence, Business Analytics Overview, Brief Introduction to Big Data Analytics, Clickstream Analysis, Metrics, Practical Solutions, Competitive Intelligence Analysis

Unit-II

Decision Making: Introduction and Definitions , Phases of the Decision Making Process, The Intelligence Phase, Design Phase, Choice Phase,Implementation Phase, Decision Support Systems: Capabilities, Classification, Components, modeling, Structure of mathematical models fordecision support; Decision making under certainty, Uncertainty and Risk, Decision modeling with spreadsheets, Mathematical programming optimization; Decision analysis-introduction , Decision tables, Decision Trees, Multi-criteria decision making, Pairwise comparisons

Unit-III

Basic Concepts of Neural Networks , Developing Neural NetworkBased Systems, Illuminating the Black Box of ANN withSensitivity, Support Vector Machines, A ProcessBased Approach to the Use of SVM, Nearest Neighbor Method for Prediction; Sentiment Analysis- Overview, Applications,Process, analytics, Speech Analytics.

Unit-IV

Automated Decision Systems, The Artificial Intelligence field ,Basic concepts of Expert Systems, Applications of Expert Systems, Structure of Expert Systems, Knowledge Engineering, Development of Expert Systems, Location based Analytics, Cloud Computing, Business Intelligence

References Books:

1. Ramesh Sharda, DursunDelen, EfraimTurban, J.E.Aronson,Ting-Peng Liang, David King, "Business Intelligence and Analytics: System for Decision Support", 10th Edition, Pearson GlobalEdition, 2013.

Course Outcomes:

After successfully completing the course the student should be able to

1. Gain knowledge on Business Intelligence, Analytics and Decision Support
2. Understand the technologies for Decision making
3. Apply predictive modeling techniques
4. Apply sentiment analysis techniques
5. Gain knowledge on Multi-criteria Decision-making systems
6. Gain knowledge on Automated decision systems

AIML Applications in IoT					
Course code	PEC-AI-409G				
Category	Professional Elective Course				
Course title	AIML Applications in IoT				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Objectives of the course:

The objective of this course are:

1. This course will introduce predictive analytics using IoT sensor data.
2. To understand how predictive analytics can be applied in different domains.
3. To understand applications of Industrial IOT.
4. To understand the role of IOT in Smart cities.

Unit-I

Introduction to Internet of Things: State of the Art in IoT, IOT reference model – IOT platforms – IOT verticals – Big data and IOT- Infusion of AI, Data Science in IOT– cross - industry standard for data mining – AI and IOT platforms,Structure of the Internet, Product developmentCycle, Applications, and impact of IoT on society**. Home IoT, Personal IoT.**
IoT Communication protocol: Basics of serial communications, HTTP protocol, MQTT protocol.
IoT Server client configurations: Defining server andclients, defining access point and station, Web server, Point to Point communication Intranet andinternet.

Unit-II

Setting up cloud services: Introduction to cloud services, how to use cloud services for IoTapplications;**Fog and Edge Computing Completing the Cloud:** Data Management in Fog Computing,
Predictive Analysis to Support Fog Application Deployment: Example: Smart Building, Predictive Analysis with FogTorch

Unit-III

Using Machine Learning for Protecting the Security and Privacy of Internet of Things (IoT) Systems: Survey of ML Techniques for Defending IoT Devices, Machine Learning in FogComputing.
AI for the Industrial IoT: Introduction to AI- powered industrial IoT – Use Cases – predictive maintenance using AI, LSTM-Advantages and disadvantages – Electrical load forecasting in industry- STLF using LSTM

Unit-IV

AI for smart Cities IoT: Smart Cities – smart traffic management – parking – waste management – Policing – lighting governance – Challenges and benefits.

Case study: Development of Mobile robot fromscratch, controlling mobile robot using smartphone over Wi-Fi, Obstacle avoidance algorithm, monitoring surrounding physical parameter using mobilephone,Anomaly Detection using IOT – Web based mobile health app using ML – Predict equipment failure using IoT sensor data – Analyze industrial equipment for defects – Detect change points in IoT sensor data – Detectvoltage anomalies in household IoT devices;Contemporary Issues

References Books:

1. M. Makkar and N. Kumar Machine Learning in Cognitive IoT (1e), CRC Press, June 2020
2. R. Buyya and S. Narayana, Fog and Edge Computing: Principles and Paradigms, (1e), Wiley, 2019.
3. R. Karim, Hands-On Deep Learning for IoT: Train neural network models to develop intelligent IoT applications. Packt Publishing Limited, 2019
4. S.McEwen, Designing the Internet of Things(1e), Wiley, 2014
5. J. Holler, Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence, Academic Press, 2014
6. Amita Kapoor, ― Hands-On Artificial Intelligence for IoT‖, Packet Publishing, 2019.
7. Andrew Minteer ―Analytics for Internet of Things‖ — Packt Publishing, 2017.

Course Outcomes:

After successfully completing the course the student should be able to

1. Understand the need of Analytics on IoT data.
2. Identify different data formats, protocols and applications of AIML on IoT data.
3. Understand different domains like Personal healthcare, home, Industrial data and smart cities data.

Intelligent Robots and Drone Technology					
Course code	PEC-AI-410G				
Category	Professional Elective Course				
Course title	Intelligent Robots and Drone Technology				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Objectives of the course:

The objective of this course are:

1. Modeling dynamic systems, measuring and controlling their behavior, and making decisions
2. Deign and simulation of a neural network
3. Apply AI that allows robots to explore complex environments
4. Design intelligent controls for robotic systems that can grasp and manipulate objects
5. Deign and simulation of any robotic device

Unit-I

Robotics Paradigm: Machine intelligence, History of Robotics, Types of Robots, Setting up your Robot: Technicalrequirements, Robot anatomy, Subsumption architecture, Display devices, Software and Hardware setup.

Foundation for Advanced Robotics and AI: The basic principle of robotics and AI, Sensing, Navigation, Planning, Uncertainty, Robot Controlsystem and a decision making framework, Robot Kinematics and Path Planning, Artificial Personality: Emotion state machine, Creating a model of human behavior, Robot emotion engine, Human emotional model

Unit-II

Concept for a Practical Robot Design Process: A systems engineering based approach to robotics: Cleaning up the environment; Use cases: Theproblem Who, What, When and Where; Storyboards: Project goals, Decomposing hardware needs,breaking down software needs, writing a specification; Task Analysis, Teaching the Robot arm:Adaptive learning rate, Q-learning implementation, indexed states and actions, Genetic algorithms

Unit-III

Object Recognition Using Neural Networks and Supervised Learning: Image recognition training and deployment process, Artificial neurons, convolution, convolutional neural network, Build the object detector.

Basic concepts of Drone: Introduction to Drone, History of Drones, three terrains, anatomy of a Drone, Drones project example –Quadcopter, Clothesline Racer, Radio-Controlled Blimp.

Unit-IV

Building a Quadcopter I : Choosing an Airframe, Choosing Between Commercial Options, MakerBeam Airframe – Parts and Steps.

Building a Quadcopter II: Motors and Props, Choose Your Motors, Outrunner Versus Inrunner, Brushed Versus Brushless, AC Versus DC, Choose Your Propellers, Prop Adapters, Steps for Attaching the Props and Motors. Current trends and Contemporary issues:

References Books:

1. Francis X. Govers, Artificial Intelligence for Robotics, Packt Publishing, O'Reilly, 2018
2. Robin R Murphy, Introduction to AI Robotics, MIT Press, 2019
3. John Baichtal, Building Your Own Drones: A Beginner's Guide to Drones, UAVs, and ROVs,2015
4. J. Craig, Introduction to Robotics Mechanics and Control, Pearson, 2018.
5. H. Asada and J.-J. Slotine, Robot Analysis and Control, J. Wiley & Sons, 1986.
6. H. Choset, Principles of Robot Motion, MIT Press, 2005.
7. G. Long, Fundamentals of Robot Mechanics, Quintus-Hyperion, 2015
8. ASA Test Prep. Remote Pilot Test Prep — UAS: Study & Prepare. Wellfleet Press, 2016. 978-1577151326
9. Austin, Unmanned Aircraft Systems: UAVS Design, Development and Deployment. Wiley, 2010. 978-0- 470-05819-0

Course Outcomes:

After successfully completing the course the student should be able to

1. Understand the basic principles behind Robotics intelligence
2. Design practical robots using appropriate measures
3. Design and simulation of neural network for image recognition
4. Understand the fundamental concepts of drone technology
5. Understand and describe basic regulations applicable to UAV flight
6. Apply principles of robotics intelligence and drone technology for solving real world problems

Artificial Intelligence for Cyber security				
Course code	PEC-AI-411G			
Category	Professional Elective Course			
Course title	Artificial Intelligence for Cyber security			
Scheme and Credits	L	T	P	Credits
	3	0	0	3
Class work	25 Marks			
Exam	75 Marks			
Total	100 Marks			
Duration of Exam	03 Hours			

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Objectives of the course:

The objective of this course are:

1. To learn the need of AI for Cyber Security
2. To learn the detection of DDOS using AI techniques
3. To learn the intrusion detection using Neural Networks
4. To learn the various applications of AI to detect cyber attacks

Unit-I

Fundamentals of AI in Cyber Security: Introduction – Problems that AI Solves – Why AI in Cyber security – Current Cyber SecuritySolutions - Structured data, Unstructured data – Supervised learning – Unsupervised learning–Reinforcement learning – classification problem - clustering problems – SVM – ANNs.

Case Study(to be carried out after completed all units): Breaking CAPTCHA using machine learning algorithm, Detecting DDoS attack using Wireshark, Malicious event detection using Machine Learning approaches, Botnet and Traffic analysis using Machine learning

Unit-II

AI and DDoS : Time series – Types of Time series – Time Series analysis in Cyber Security – Detecting DDOS withTime Series – Predicting DDOS attacks – Ensemble Techniques for Cyber security – Types of Ensemble – Types of Ensemble Algorithms – Bagging, Boosting, Stacking, Bayesian Model -Ensemble Method to detect Cyber attack.

Detection of malicious web pages, URLs:URL Blacklisting – Drive by download URL- Command and Control URLs – Phishing URLs – UsingHeuristics to detect Malicious Pages – Data for the analysis – Feature Extraction – Lexical Features–Web Content based Features – Host based features – site Popularity features.

Unit-III

CAPTCHA and Scan Detection: Using AI to crack CAPTCHA – Types of CAPTCHA – ReCAPTCHA – Breaking a CAPTCHA –Solving CAPTCHA with neural network - Machine Learning in Scan Detection - Machine-Learning Applications in Scan Detection

Context based Malicious event detection : Context based Malicious event detection – Adware – Bots – Bugs – Ransomeware – Rootkit –Spyware – Trojan horses – Viruses – Worms – Malicious Injections in Wireless networks.

Unit-IV

AI and IDS : Architecture of IDS based on Neural networks – Intelligent flow based IDS - Multi-Agent IDS – AIbased Ensemble IDS – Machine Learning in Hybrid Intrusion Detection Systems - Machine-Learning Applications in Hybrid Intrusion Detection: Anomaly - Misuse Sequence Detection System- Parallel Detection System.

AI and Mail Server : Types of Mail Server – Data Collection from mail server – Naive Bayes theorem to detect spam –Laplace smoothing – Featurization Techniques to covert text based emails to numeric values –Logistic regression to spam filters - Anomaly detection techniques for SMTP and HTTP; Contemporary issues in Artificial Intelligence for Cyber security.

Reference Books:

1. Hands-On Machine Learning for Cyber Security: Safeguard your system by making your machine intelligence using the python ecosystem, Soma Harder, Sinan Ozdemir, Packt Publishing Ltd, 2018.
2. The state of the Art in Intrusion Detection System, AI-Sakib Khan Pathan, CRC Press, Taylor & Francis Group, 2014
3. Data Mining and Machine Learning in Cyber Security, Sumeet Dua and Xian Du, CRC Press, 2011.
4. Cybersecurity for Dummies, Brian Underdahl, Wiley, 2011
5. Cryptography and Network security, Behrouz A. Forouzan , Debdeep Mukhopadhyay, Mcgraw Hill Education, 2nd Edition, 2011

Course Outcomes:

After successfully completing the course the student should be able to

1. Understand the cyber threats, attacks and vulnerabilities and its defensive mechanism
2. Understand and implement various AI techniques to detect cyber attacks
3. The recent challenges in AI related to cyber security and able to develop new security solutions to the real time applications

AI in Healthcare					
Course code	PEC-AI-413G				
Category	Professional Elective Course				
Course title	AI in Healthcare				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Objectives of the course:

The objective of this course is:

1. To understand the basics of AIML.
2. To describe and understand the use of AI for diagnosis and patient monitoringin the real world.
3. To demonstrates the uses of extract value-adding outcomes from medical literature using AI Techniques.

Detailed Course

Unit-I

AI and Machine Learning: Application and Foundations, Become familiar with supervised machine learning and the types of problems it may be applied to; Real world Case Studies

Unit-II

Using AI for Disease Diagnosis and Patient Monitoring: Examine real-world applications of AI for diagnosis and patient monitoring; Real world Case Studies

Unit-III

Natural Language Processing and Data Analytics in Healthcare: Use AI to extract value-adding outcomes from medical literature and pathology reports; Real world Case Studies

Unit-IV

Interpretability in Machine Leaning – Benefits and Challenges: Appreciate the importance and benefits of interpretable algorithms.
Real world case studies.

References Books:

1.P. S. Mahajan, Artificial Intelligence in Healthcare Paperback, July 1, 2018.

2.A. Bohr and K. Memarzadeh, Artificial Intelligence in Healthcare, Academic Press, 2020
3.S. Dua, U. Acharya and P. Dua, Machine Learning in Healthcare Informatics, Springer, 2014
4.A. Panesar, Machine Learning and AI for Healthcare: Big Data for Improved Health Outcomes, Academic Press; (1e), 5 February 2019

Course Outcomes:

After successfully completing the course the student should be able to

1. Knowhow the basics of AIML.
2. Got insight of the use of AI for diagnosis and patient monitoringin the real world.
3. Manage the uses of extract value-adding outcomes from medical literature using AI Techniques.

Machine Learning for Medical Image Analysis					
Course code	PEC-AI-412G				
Category	Professional Elective Course				
Course title	Machine Learning for Medical Image Analysis				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Objectives of the course:

The objective of this course are:

1. To understand the medical imaging modalities
2. To focus on the analysis of clinical parameters for the extraction of knowledge from medicalimages
3. To integrate machine intelligence to automate the process in the medical imaging

Detailed Course

Unit-I

Fundamentals of Medical Image Processing: Principles of Image Formation – Coordinate System: Body – Scanner – Scene – Structure –Display; Image Enhancement using Histogram Processing – Noise suppression: Image Filtering: Gaussian Filtering – Median Filtering – Unsharp Masking– Adaptive Filtering Edge Detection- Image Quality Metrics – Image Artifacts – Linear Filtering – Convolution and Correlation- Algorithms to remove noise

Unit-II

Segmentation and Morphological Operations: Image Segmentation – Region Based – Edge Based – Morphological Operations – Dilation – Erosion – Chain code – Feature Extraction;
Radiography and Magnetic Resonance Imaging : X-rays; interaction of x-ray beam with tissue; X-ray detectors; X-ray detectors in CT; Data acquisition in CT; image reconstruction; spiral CT – MRI - Image acquisition and reconstruction; interaction with tissue; slice selection; basic pulse sequences; 3D-imaging; fast imaging methods; functional imaging

Unit-III

Ultrasonic Imaging: Physics of acoustic waves propagation in tissues; generation and detection of ultrasound; B-mode; M-mode; TM-mode processing; date acquisition.- Types of noise – Noise Removal

Nuclear Medical Imaging and Diagnosis: Cancer Diagnosis – Monitor the effects of chemo therapy on tumor volume – Cardiovascular disease – to examine the blood flow to the heart muscle – Neurological disorders – brain tumor evaluation and early identification of recurrence

Unit-IV

Machine Intelligence : Data labelling – Feature Computation and selection – The learning process – Neuronal algorithms: Bayes Classifier, Linear Classifier, Decision trees , Random forests, Neural networks to diagnose a wide variety of medical conditions such as screening for common cancers- classify tumors in PET images/ – – Automated CT Scanners - Deep learning architectures for segmentation – U-Net;

Future Trends in Medical Imaging: Optical Imaging – Optical Coherence Tomography – Diffuse Reflectance and Trans illumination Imaging – Model Based and Multiscale Analysis- Diffusion Tensor Imaging – Thermography Microwave imaging

References Books:

1. Biomedical Image Analysis, Rangaraj M. Rangayyan, 2004
2. Medical Image Analysis, A. Dhawan, Wiley 2003
3. Foundations of Medical Imaging, Cho, Jones, Singh, John Wiley & Sons, 1993
4. Fundamentals of Medical Imaging, Paul Suetens, Cambridge University, 2nd edition, 2009
5. Deep Learning for Medical Image Analysis, S. Kevin Zhou, Hayit Greenspan, Dinggang Shen, Academic Press, ISBN: 9780128104095, 2017

Course Outcomes:

After successfully completing the course the student should be able to

1. Understand the fundamentals of medical imaging system
2. Learn to extract, model, and analyse information from medical data
3. To develop applications to help diagnosis, treatment and monitoring of diseases through
4. machine intelligence algorithms
5. Understand the working of deep learning models for medical imaging

Speech and Language Processing using Deep Learning				
Course code	PEC-AI-414G			
Category	Professional Elective Course			
Course title	Speech and Language Processing using Deep Learning			
Scheme and Credits	L	T	P	Credits
	3	0	0	3
Class work	25 Marks			
Exam	75 Marks			
Total	100 Marks			
Duration of Exam	03 Hours			

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Objectives of the course:

1. Be competent with fundamental concepts for natural language processing and automatic speech recognition
2. To understand technologies involved in developing speech and language applications.
3. To demonstrate use of deep learning for building applications in speech and natural language processing

Unit-I

N-gram Language Models: Overview of NLP - Understanding Words – Corpora – Bag of Words - Text normalization –Ngrams-Smoothing-Perplexity
Word Embedding: Lexical & word semantics – Words and vectors – Cosine similarity – Vector-Space models – TFIDF– Word2vec– Bias and embedding – Evaluating vector models

Unit-II

Sequence Processing:Text Classification – Sentiment Analysis – Recurrent neural networks – Context in RNNs – Transformer networks – Machine translation – Encoder-decoder RNNs – Attention – Beam search – Evaluation of translation.
Dialogue Systems: IR based question answering system – Entity linking – Knowledge based Q&A – Language models for Q&A – Evaluation of systems – Chatbots – Human dialogue – Frame based dialogue – Dialogue state architecture – Evaluating dialogue systems.

Unit-III

Speech Production and Perception:Fundamentals of speech production – Short-Term Fourier representation of Speech – Functions of the ear – Perception of sound – Vocal tract model .
Speech Signal Processing:Short-Time analysis of the signal – Energy – Zero crossing – Autocorrelation – Short time Fourier analysis - Spectrogram – Filter-banks – Cepstrum – Linear Predictive Coding – Mel-Frequency Cepstrum

Unit-IV

Automatic Speech Recognition: Automatic Speech recognition formulation – HMM based speech recognition – Isolated word recognition – Large vocabulary continuous speech recognition – Deep learning for language modeling and automatic speech recognition – Evaluation metrics. Speaker recognition – Alexa/Google assistant based application development.

Recent Trends and Contemporary Issues

References:

1. Speech and Language Processing, 3rd Ed., DanielJurafsky& James H. Martin, 2020.
2. Theory and Applications of Digital Speech Processing, Lawrence R. Rabiner, Ronald W. Schafe, 1stEdn. Pearson, 2010.
3. Digital Speech Processing Using Matlab, E. S. Gopi, Springer, 2014
4. Voice Applications for Alexa and Google Assistant, Dustin Coates, Manning Publications, 2019.
5. Speech and Audio Processing A MATLAB -based Approach, Ian Vince, McLoughlin, Cambridge Press, 2016.
6. Natural Language Processing with TensorFlow, ThushanGanegedara, Packt, 2018
7. An Introduction to Voice Computing in Python, Jim Schwoebel, NeuroLex, 2018
8. Text Analytics with Python, Dipanjan Sarkar, Apress, 2019

Course Outcomes:

After successfully completing the course the student should be able to

1. Describe ways to represent speech and words
2. Demonstrate the working of sequence models for text
3. Adapt a dialogue system to a specific domain
4. Use signal processing techniques to analyze/represent the speech signal
5. Execute trials of speech/language systems

Image and Video Analytics				
Course code	PEC-DS-406G			
Category	Professional Elective Course			
Course title	Image and Video Analytics			
Scheme and Credits	L	T	P	Credits
	3	0	0	3
Class work	25 Marks			
Exam	75 Marks			
Total	100 Marks			
Duration of Exam	03 Hours			

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Objectives of the course:

1. To impart knowledge on the concepts of computer vision and intelligent video processing with analytics to process massive video feed and derive insights with machine intelligence
2. To explore and demonstrate real time video analytics in solving practical problems of commercial and scientific interests.

Unit-I

Introduction Digital Image Processing: Characteristics of Digital Image, basic relationship between pixels, fundamental operations on image, image sampling and quantization, image transformations models;

Unit-II

Basic Techniques of image processing Fundamentals of spatial filtering: spatial correlation and convolution, smoothing blurring, sharpening, basics of filtering in the frequency domain: smoothing, blurring, sharpening, histograms and basic statistical models of image;

Unit-III

Transformations andSegmentations: Colour models and Transformations, image and video Segmentation, image and videodemonising, image and Video enhancement- Image and Video compression;

Unit-IV

Detection andClassification Object detection and recognition in image and video, texture models Image and videoclassification models object tracking in Video; **Applications and Case studies Industrial**-Transportation& travel, remote sensing, video Analytics: IoT Video Analytics Architectures.

References:

1. R.C Gonzalez and R.E Woods, *Digital Image Processing*, Pearson Education, 4th edition, 2018.
2. N.M. Tekalp, *Digital Video Processing*, (1e), Pearson, 2017
3. A.K. Jain, *Fundamentals of Digital Image Processing*, PHI, New Delhi, 1995
4. Rick Szelisk, *Computer Vision: Algorithms and Applications*, Springer 2011.

5. C. Shan, F. Porikli, T. Xiang and S. Gong, *Video Analytics for Business Intelligence*,(1e), Springer, 2012

Course Outcomes:

After successfully completing the course the student should be able to

1. Understand basic image and video processing concepts
2. Explore both the theoretical and practical aspects of intelligent perception and understanding of images.
3. Apply principles and techniques of video processing in applications related to intelligent and automated visual system design and analysis.
4. Analyze techniques for action representation and recognition
5. Develop algorithms that can perform high-level visual recognition tasks on real-world images and videos.

Intelligent Information Retrieval				
Course code	PEC-AI-415G			
Category	Professional Elective Course			
Course title	Intelligent Information Retrieval			
Scheme and Credits	L	T	P	Credits
	3	0	0	3
Class work	25 Marks			
Exam	75 Marks			
Total	100 Marks			
Duration of Exam	03 Hours			

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Objectives of the course:

1. To familiarize with boolean and vector space retrieval models; evaluation and interface issues,text index construction and scoring
2. To develop intelligent systems by applying the methods such as Prediction, Forecasting,
3. Classification, Clustering and Optimization
4. To build working systems that assist users in finding useful information on the Web

Unit-I

Fundamentals of IR Systems, Models and Indexing : Overview of IR Systems, Information retrieval using the Boolean model, The dictionary and postings lists, Tolerant retrieval, Automatic Indexing, Index construction and compression, Scoring, Vector space model and term weighting;
Document Representation and Analysis: Statistical Characteristics of Text, Regular Expressions, Text Normalization, Edit Distance, N- Gram Language Models, Naive Bayes and Sentiment Classification-Logistic Regression for Document Analysis.

Unit-II

Query Processing and Evaluation: Basic Query Processing, Data Structure and File Organization for IR, Evaluation in information retrieval-Relevance feedback, User Profiles, Collaborative Filtering and query expansion;
Retrieval Models: Similarity Measures and Ranking, Boolean Matching, Vector Space Models, Probabilistic Models, XML Retrieval, Language models for information retrieval.

Unit-III

Text Classification and Clustering: Text classification-vector space classification-support vector machines and machine learning ondocuments-Clustering-flat clustering- hierarchical clustering- Matrix decompositions and Latentsemantic indexing;
Web Search Analysis: Web search basics. web characteristics-index size and estimation- near duplicates and shingling- web crawling-distributing indexes- connectivity servers-link analysis-web as a graph-PageRank-Hubs and authoritative pages- summarization-question answering.

Unit-IV

Web Mining and Online IR Systems : Web mining and its applications-Mining Twitter, Facebook, Instagram, Linkedin, Mailboxes and Git Hub. Online IR systems- online public access catalogs-digital libraries-architectural issues- document models -representations and access protocols
Recent Trends and Contemporary Issues

References Books:

1. C. D. Manning, P. Raghavan, and H. Schutze, Introduction to Information Retrieval, Cambridge University Press (2008)
2. Ricardo Baezce Yates, Berthier Ribeiro-Neto, Modern Information Retrieval: The Concepts and Technology behind Search (2ndEd, 2010)
3. Mikhail Klassen, Matthew A. Russell, Mining the Social Web,O'Reilly Media, Inc., 3rd Edition (2019)
4. Ceri, S., Bozzon, A., Brambilla, M., Della Valle, E., Fraternali, P. and Quarteroni, S.,2013. Web information retrieval. Springer Science & Business Media.
5. D. Jurafsky, and J. Martin, Speech and language processing : an introduction to naturallanguage processing, computational linguistics, and speech recognition, Pearson PrenticeHall, Second Edition (2013)
6. Giles, Mark Smith, John Yen, Advances in Social Network Mining and Analysis ,Springer,2010
7. Bruce Croft, Donald Metzler and Trevor Strohma, Search Engines: Information Retrieval in Practice (1st Ed 2009)

Course Outcomes:

After successfully completing the course the student should be able to

1. Describe the genesis and variety of information retrieval situations;
2. Construct the variety of information retrieval models and techniques;
3. Execute methods and principles of information retrieval systems;
4. Develop Methods for implementing information retrieval systems;
5. Interpret Characteristics of operational and experimental information retrieval systems;
6. Evaluate the emerging information retrieval practices in library services and on the Web

Open Electives

Open Source Programming

Course code	OEC-DS-431G				
Category	OpenElective Course				
Course title	Open Source Programming				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Objectives of the course:

The objective of this course are:

4. To comprehend and analyze the basic concepts of web frameworks
5. To describe how different frameworks work and to choose the framework depending on the application.
6. To demonstrates the uses of different web frameworks.

Detailed Course

Unit-I

Django Framework: Introduction and Installation – MVT Structure – Creating a project and app in Django – Django, Forms – creation of forms – render forms - form fields – form fields widgets – formsets – Django Templates– Template filters – Template Tags – Variables – Operators – for loop- If-Django Templates – Templateinheritance

Django Model: Django Views – Function based views – Class based generic views – Models – ORM – Basic App Model –Intermediate fields - Uploading Images – Render Model – Build-in and custom field validations – HandlingAjax Request – Django Admin interface

Unit-II

Ruby on Rails Framework : Ruby of Rails introduction – Installation – MVC architecture - IDE – Rails scripts - Directory structure- Database setup – Active records - RVM– Bundler - Rails Migration – controllers –routes– views – layouts - scaffolding – sessions – file upload – filters - Ajax

ExpressJS: Introduction – installation – Node JS Environment Setup – Routing – HTTP Methods – URLBuilding – Middleware – Templating – Different template Engines– Static Files – Form Data

Unit-III

ExpressJS& Database: Database– Mongo DB – Mongoose – Cookies,sessions – Authentication – RESTFUL APIs – Scaffolding – Error Handling – File upload

Angular JS: Introduction – Environment setup – First application – Data binding & Directives – Expressions – Controllers – Scopes – Events – Services – Filters - Modules

Unit-IV

Angular JS – Routing: HTML DOM -Forms – Validation – Routing – Includes – AJAX – Views – Dependency Injection- Custom Directives – Single Page applications

Recent Trends and contemporary issues

References Books:

1. AidasBendoraitis, Jake Kronika, Django 3 Web Development Cookbook: Actionable solutions to common, Packt Publishing; 4th edition, 2020.
2. Michael Hartl, Ruby on Rails Tutorial, Addison-Wesley Professional; 6th edition, 2020.
3. Adam Freeman, Pro Angular 9: Build Powerful and Dynamic Web Apps, Apress, 4th Edition,2020.
4. Ethan Brown, Web Development with Node and Express, 2e: Leveraging the JavaScript Stack, O′Reilly; 2nd edition, 2019.
5. Lopatin, Ben, Django Standalone Apps, Apress, 1st Edition, 2020.
6. Simon D. Holmes and Clive Harbe, Getting MEAN with Mongo, Express, Angular, and Node, Second Edition, Manning Publications,2017.

Course Outcomes:

After successfully completing the course the student should be able to

1. Use Django framework to create basic website.
2. Use Ruby on Rails framework to quickly develop websites.
3. Use Express framework along with Node JS to render webpages effectively
4. Use Mongo DB along with Express to display dynamic web content
5. Use Angular JS to extend an enhance HTML pages
6. Implementing web-based solution effectively using different web frameworks.

Data Visualization& Tableau	
Course code	OEC-AI-431G
Category	OpenElective Course

Course title	Data Visualization& Tableau				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Course objectives:

The basic objective is to understand the data analysis & visualize your data & method not just a tool-oriented Analyst.

Unit-I

Overview of Data analysis, Introduction to Data visualization,Working with statistical formulas - Logical and financial functions,Data Validation& data models, Power Map for visualize data, Power BI-Business Intelligence, Data Analysis using statistical methods, Dashboard designing.

Unit-II

Heat Map, Tree Map, Smart Chart, Azure Machine learning, Column Chart, Line Chart , Pie, Bar, Area ,Scatter Chart, Data Series ,Axes ,Chart Sheet ,Trendline, Error Bars, Sparklines, Combination Chart, Gauge, Thermometer Chart ,Gantt Chart ,Pareto Chartetc,Frequency, Distribution, PivotChart, Slicers, Tables: Structured References, Table Styles, What-If Analysis: Data Tables, GoalSeek, Quadratic Equation Transportation Problem, Maximum Flow Problem, Sensitivity Analysis, Histogram, Descriptive,Statistics,Anova ,F-Test,t-Test ,Moving,Average ,Exponential Smoothing, Correlationmodel, Regressionmodel; SQL- Overview, data types, operators, database query operations

Unit-III

What is Tableau? What does the Tableau product suite comprise of? How Does Tableau Work?Tableau Architecture, What is My Tableau Repository?, Connecting to Data & Introduction to data source concepts, Understanding the Tableau workspace, Dimensions and Measures, Data Types & Default Properties, Tour of Shelves & Marks Card, Using Show Me!, Building basic views, Saving and Sharing your work-overview, Demo related to above.

Unit-IV

Tableau Date Aggregations and Date parts,Cross tab & Tabular charts, Totals & Subtotals, Bar Charts & Stacked Bars, Trend lines, Reference Lines, Forecasting, Filters, Context filters, Line Graphs with Date &Without Date, Tree maps, Scatter Plots, Individual Axes, Blended Axes, Dual Axes & Combination chart, Edit axis, Parts of Views, Sorting.Demo related to above.

Books Recommended

- Big Data Analytics Beyond Hadoop: Real-Time Applications with Storm, Spark, and More Hadoop Alternatives, 1e Pearson Education India; 1 edition (2015)
- Big Data Fundamentals: Concepts Drivers: Concepts, Drivers and Techniques, Erl/Khattak/Buhler, Pearson Education India; First edition (2016)
- Ebook: Data Visualization Tools (Innovation Trends Series), BBVA Innovation Center, Kindle Edition

Course Outcomes:

On completion of this course, the students will be able to understand the data analysis & visualize your data & method not just a tool-oriented Analyst.

1. Understand data fundamental, analyse the data methodology, techniques, powerful dashboards, Power BI & Visualization power of data along with a strong focus on case studies to ensure hands on learning.
2. Learn the powerful data visualization tool like Advanced version of Excel, Power Map, Power BI, Business Intelligence software, Tableau software & other open source tools etc to present your analysis.

Information Storage and Management	
Course code	OEC-DS-432G

Category	OpenElective Course				
Course title	Information Storage and Management				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Objectives of the course:

The objective of this course are:

1. Understand the components of storage infrastructure.
2. Gain knowledge to evaluate storage architectures including storagesubsystems
3. Understand the business continuity, backup and recovery methods.
4. Acquire knowledge on information security framework
5. Introduce the working principle of storage infrastructure with monitoring principles
6. Understand the structure of cloud computing and its techniques

Detailed Course

Unit-I

Introduction to Information Storage Management, Evolution of Storage Architecture, Data Centre Infrastructure, Virtualization and Cloud Computing, Key challenges in managing information, Data Center Environment: Application, Database Management System (DBMS), Host : Connectivity, Storage Disk Drive Components,Disk Drive Performance, Intelligent Storage System and its Components, Storage Provisioning, Types of Intelligent Storage Systems, Creation of Virtual storage machine , Navigation of storage system .

Unit-II

Virtualization and Cloud Computing : FiberChannel: Overview , SAN and its Evolution , Components of FC SAN, FCConnectivity,FC Architecture, IPSAN-iSCSI components, iSCSI Protocol StackiSCSI Names; NAS: General Purpose Servers versusNAS Devices, Benefits of NAS- File Systems andNetwork File Sharing, Components of NAS, I/O Operations, Implementations, File Sharing Protocols; Object Based Storage Devices, Content Addressed Storage, Configuration and Tracing of FC scan and
iSCSI scan

Unit-III

Business Continuity And Back UpRecovery :Business Continuity: Information Availability, BC- Terminology, Planning life cycle, Failure Analysis, Business Impact Analysis, Technology Solutions; Backup and Archive: Backup Purpose , Backup Considerations, Backup Granularity, Recoveryconsiderations, Backup Methods, Backup Architecture, Backup and Restore Operations, Backup Topologies, Backup in NAS Environments, Backup Targets, Data Deduplication forBackup , Backup in Virtualized Environments, Sharing Files between host and VirtualMachines, Usage of Backup techniques.

Unit-IV

Storage Security And Management : Information Security Framework , Risk Triad, Storage SecurityDomains, Security Implementations in StorageNetworking, Securing Storage Infrastructure inVirtualized and Cloud Environments, RSA and VMware Security Products, Monitoring the Storage Infrastructure, Monitoring Parameters,Components Monitored, Monitoringexamples, Storage Infrastructure Management Activities, Storage Infrastructure ManagementChallenges, Storage ManagementExamples, Storage Allocation to a New Server/Host;

Cloud Computing:Cloud Enabling Technologies, Characteristics, Benefits, Service Models, Deployment models;Cloud Infrastructure Mechanism: Logical Network Perimeter, Virtual Server, Storage Device, Usage Monitor, Resource Replication, Ready Made environment, Challenges, Container, Adoption Considerations, Usage of Cloud services with open sourcecloud tools (like Eucalyptus, Openstack,Open Nebula and others)

References Books:

1. EMC Corporation, "Information Storage and Management",2nd edition Wiley India, ISBN13:978-1118094839
2. Thomas Erl, "Cloud Computing: Concepts, Technology & Architecture", Prentice Hall, 2013, ISBN:9780133387568
3. UifTroppen Rainer Wolfgang Muller,"Storage Networks Explained", India, Wiley, 2010, ISBN13: 978-0470741436

Course Outcomes:

After successfully completing the course the student should be able to

1. Acquire the knowledge on the components of storage infrastructure
2. Acquire the ability to evaluate storage architectures including storagesubsystems
3. Understand the business continuity, backup and recovery methods.
4. Appreciate the concepts of storage security and information security applied to virtual machine
5. Apply the knowledge for storage infrastructure
6. Acquire the knowledge on structure of cloud computing and its techniques

Virtualization					
Course code	OEC-DS-433G				
Category	OpenElective Course				
Course title	Virtualization				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Objectives of the course:

The objective of this course are:

1. To identify and select suitable hypervisor for a cloud environment.
2. To acquire the knowledge of various virtualization techniques and tools.
3. To understand the process of data center automation and secure virtualized environment.

Unit-I

Introduction : Characteristics Virtualization definition – virtual machine basics – benefits – need for virtualization – limitations –traditional vs. contemporary virtualization process – virtual machines – taxonomy – challenges.
Hypervisors : Introduction to Hypervisors – Type 1 Hypervisors – Type 2 Hypervisors – comparing hypervisors – virtualization considerations for cloud providers.

Unit-II

Hardware Virtualization: Full virtualization - para virtualization - server virtualization - OS level virtualization - emulation – binary translation techniques – managing storage for virtual machines

Types of Virtualization: Application virtualization - desktop virtualization - network virtualization - storage virtualization - comparing virtualization approaches.

Unit-III

Virtualization Management: Management life cycle - managing heterogeneous virtualization environment – customized and modifying virtual machines – virtual machine monitoring – management tools.
Automation: Benefits of data center automation – virtualization for autonomic service provisioning – software defined data center - backup - disaster recovery.

Unit-IV

Security: Mapping Design (Models) to Code – Testing - Usability – Deployment – Configuration Management – Maintenance; Current trends and Contemporary issues

References Books:

1. Nelson Ruest, Danielle Ruest, Virtualization, A beginners guide, 2009, MGH.
2. Nadeau,TimCerng, Je Buller, Chuck Enstall, Richard Ruiz, Mastering MicrosoftVirtualization, Wiley Publication, 2010.
3. William Von Hagen, Professional Xen Virtualization, Wiley Publication, 2008.
4. Matthew Portney, Virtualization Essentials, John Wiley & Sons, 2012.
5. Dave Shackleford, Virtualization security, protecting virtualized environment, John Wiley, 2012.

Course Outcomes:

After successfully completing the course the student should be able to

1. Illustrate the process of virtualization.
2. Create and configure the hypervisors in cloud.
3. Apply the virtualization concepts in server and manage the storage capacity.
4. Analyze, identify and select suitable type of virtualization.
5. Use the management tools for managing the virtualized cloud infrastructure.
6. Apply suitable automation and security methods on data centre

R Programming					
Course code	OEC-AI-434G				
Category	OpenElective Course				
Course title	R Programming				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Objectives of the course: The objective of this course are:

1. Understand what R is and what it can be used for
2. Why would you choose R over another tool
3. Troubleshoot software installs (keep your fingers crossed)
4. Gain familiarity with using R from within the RStudio IDE
5. Get to know the basic syntax of R functions
6. Be able to install and load a package into your R library

Details Syllabus

Unit-I

INTRODUCTION: Getting **R,** R Version, 32-bit versus 64-bit, The **R** Environment, Command Line Interface, RStudio, Revolution Analytics RPE. **R** Packages: Installing Packages, Loading Packages, Building a Package. R Basics: Basic Math, Variables, Data Types, Vectors, Calling Functions, Function, Documentation, Missing Data, Advanced Data Structures: data frames, Lists, Matrices, Arrays.

Unit-II

R DATA : Reading Data into **R:** Reading CSVs, Excel Data, Reading from Databases, Data from OtherStatistical Tools, R Binary Files, Data Included with R, Extract Data from Web Sites, Statistical Graphics: Base Graphics, ggplot2.

R FUNCTIONS & STATEMENTS: Writing **R** Functions: Hello, World!, Function Arguments, Retum Values, do.call, Control Statements: if and else, switch, ifelse, Compound Tests, Loops: for Loops, while Loops, Controlling Loops.

Unit-III

DATA MANIPULATION: Group Manipulation: Apply Family, aggregate, plyr, data.table, Data Reshaping: cbind and rbind, Joins, reshape2, Manipulating Strings: paste, sprint, Extracting Text, Regular.

R STATISTICS & LINEAR MODELING: Probability Distributions: Normal Distribution, Binomial Distribution, Poisson, Basic Statistics: Summary Statistics, Correlation and Covariance, T-Tests 200, ANOVA, Linear Models: Simple Linear Regression, Multiple Regression, Generalized Linear Models: Logistic

Regression, Poisson, Model Diagnostics: Residuals, Comparing Models, Cross-Validation, Bootstrap, StepwiseVariable Selection

Unit-IV

NON-LINEAR MODELING: Nonlinear Models: Nonlinear Least Squares, Splines, Generalized Additive Models, DecisionTrees, Random Forests, Clustering: K-means, PAM, Hierarchical Clustering

Course Outcomes:

After completion of the course, students will be able to:

1. Familiarize themselves with R and the RStudio IDE
2. Understand and use R functions
3. Install and load a package into your R library
4. Get insight into the capabilities of the language as a productivity tool for data manipulation and statistical analyses.

REFERENCES:

- Jared P. Lander, R for Everyone: Advanced Analytics and Graphics, Pearson Edu. Inc.
- Christian Heumann, Michael Schomaker and Shalabh, Introduction to Statistics and Data Analysis - With Exercises, Solutions and Applications in R , Springer, 2016
- Pierre Lafaye de Micheaux, Rémy Drouilhet, Benoit Liquet, The R Software Fundamentals of Programming and Statistical Analysis, Springer 2013
- Alain F. Zuur, Elena N. Ieno, Erik H.W.G. Meesters, A Beginner's Guide to R (Use R) Springer 2009

Essentials of Hadoop					
Course code	OEC-AI-436G				
Category	OpenElective Course				
Course title	Essentials of Hadoop				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Objectives of the course:

Provide the skills needed for building computer system for various applications in a career in Computer Science field.

1) Explain the characteristics of Big Data
2) Describe the basics of Hadoop and HDFS architecture
3) List the features and processes of MapReduce
4) Describe the basics of Pig

Unit-I

What is Big Data and where it is produced? Rise of Big Data, Compare Hadoop vs traditional systems, Limitations and Solutions of existing Data Analytics Architecture, Attributes of Big Data, Types of data, other technologies vs Big Data.

Hadoop Architecture and HDFS - What is Hadoop? Hadoop History, Distributing Processing System, Core Components of Hadoop, HDFS Architecture, Hadoop Master – Slave Architecture, Daemon types - Learn Name node, Data node, Secondary Name node.

Unit-II

Hadoop Clusters and the Hadoop Ecosystem- What is Hadoop Cluster? Pseudo Distributed mode, Type of clusters, Hadoop Ecosystem, Pig, Hive, Oozie, Flume, SQOOP. Hadoop MapReduce Framework - Overview of MapReduce Framework, MapReduce Architecture, Learn about Job tracker and Task tracker, Use cases of MapReduce, Anatomy of MapReduce Program.

Unit-III

MapReduce programs in Java- Basic MapReduce API Concepts, Writing MapReduce Driver, Mappers, and Reducers in Java, Speeding up Hadoop Development by Using Eclipse, Unit Testing MapReduce Programs, and Demo on word count example.

Hive and HiveQL- What is Hive?, Hive vs MapReduce, Hive DDL – Create/Show/Drop Tables, Internal and External Tables, Hive DML – Load Files & Insert Data, Hive Architecture & Components, Difference between Hive and RDBMS, Partitions in Hive.

Unit-IV

PIG vs MapReduce, PIG Architecture & Data types, Shell and Utility components, PIG Latin Relational Operators, PIG Latin: File Loaders and UDF, Programming structure in UDF, PIG Jars Import, limitations of PIG. Apache SQOOP, Flume

- Why and what is SQOOP? SQOOP Architecture, Benefits of SQOOP, Importing Data Using SQOOP, Apache Flume Introduction, Flume Model and Goals, Features of Flume, Flume Use Case.

HBase- What is HBase? HBase Architecture, HBase Components, Storage Model of HBase, HBase vs RDBMS, Introduction to Mongo DB, CRUD, Advantages of MongoDB over RDBMS, Use case.

Oozie and Zookeeper

Topics - Oozie – Simple/Complex Flow, Oozie Workflow, Oozie Components, Demo on Oozie Workflow in XML, What is Zookeeper? Features of Zookeeper, Zookeeper Data Model

Reference Books:

1. Hadoop – The Definitive Guide by Tom White, 4th EditionORelly, 2015
2. Expert Hadoop Administration: Managing, Tuning, and Securing Spark, YARN, and HDFS by Alapati Sam R.,2017
3. Big Data and Hadoop- Learn by Exampleby Mayank Bhushan,BPB Pub,2018
4. Big Data and Hadoop by V. K. Jain, Khana Pub., 2017

Course Outcomes:

1. Understanding of Big Data problems with easy to understand examples.
2. History and advent of Hadoop right from when Hadoop wasn't even named Hadoop.
3. What is Hadoop Magic which makes it so unique and powerful.
4. Understanding the difference between Data science and data engineering, which is one of the big confusions in selecting a carrier or understanding a job role.
5. And most importantly, demystifying Hadoop vendors like Cloudera, MapR and Hortonworks by understanding about them.

Intelligent Vehicle Technology					
Course code	OEC-ME-451G				
Category	OpenElective Course				
Course title	Intelligent Vehicle Technology				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Objectives of the course:

The objective of this course are:

1. Acquire knowledge of about Intelligent vision system
2. Know the architecture of Intelligent transportation system
3. Impart the techniques of adaptive control
4. Know the architecture for autonomous vehicles
5. Study the autonomous vehicle cases

Detailed Course

Unit-I

Introduction to Intelligent Vision System: Vision Based Driver Assistance System –Vehicle optical Sensor , Laser Radar, Non Contact ground velocity detectingSensor, Road Surface Recognition Sensor, Vehicle Sensors for Electronic TollCollection System, Components of a Vision Sensor System; Driver Assistance on Highways –LaneRecognition, TrafficSign Recognition; Driver Assistance in Urban Traffic-StereoVision , Shapebase analysis, Pedestrian Recognition

Unit-II

Vehicle Information System and Intelligent Transportation: Intelligent Transportation System (ITS) – Vision for ITS Communications, Multimedia communication in a car, Current ITS Communication Systems andServices, Vehicle to Vehicle CommunicationSystems, Road to Vehicle CommunicationSystems, Inter Vehicle Communication, Intra Vehicle Communication, VANETS-Devices, Optical Technologies, Millimeter Wave technologies

Unit-III

Adaptive Control Techniques for Intelligent Vehicles: Automatic Control Of Highway Traffic AndMoving Vehicles, Adaptive Control Of Highway Traffic AndMoving Vehicles, Adaptive Control Overview, Gain Scheduling, Model Reference Adaptive Control, Self-Tuning Adaptive Control System

Model, System Identification Basics,Recursive Parameter Estimation, Estimator Initialization, Design Of Self-Tuning Controllers, Generalized Minimum Variance (GMV)Control, Pole Placement Control
Model Predictive Control Overview andExamples.
Decisional Architectures for Autonomous Vehicles: Control Architectures, Motion Autonomy, Deliberative Architectures, Reactive Architectures, Hybrid Architecture Overview and Examples,

Unit-IV

Decisional Architectures for Autonomous Vehicles: Overview Of Sharp Architecture,Models Of Vehicles, Concepts Of Sensor Based Maneuver, Reactive Trajectory Following,Parallel Parking , Platooning, Main Approaches To Trajectory Planning,Non-Homonymic Path Planning.
Autonomous Vehicle and Case Studies:DARPA Challenge Case Study, ARGO Prototype Vehicle, The Gold System, The inverse Perspective Mapping, Lane Detection, Obstacle Detection, Vehicle Detection, Software systems architecture, Computational Performances, ARGO Prototype vehicle Hardware, Functionalities-ARGO Prototype vehicle, Data acquisition System, Processing System, Control System, Overview Pedestrian Detection

References Books:

1. LjuboVlacic, Michel Parent and Fumio Harashima, "Intelligent Vehicle Technologies", Butterworth - Heinemann publications, Oxford, 2001-ISBN 0 7506 5093 1
2. Ronald K Jurgen, "Automotive Electronics Handbook ", Automotive Electronics Series, SAE, USA, 1998.
3. NicuBizon,Lucian D Ascalescu And NaserMahdavitAbatabaei "Autonomous Vehicles

Course Outcomes:

After successfully completing the course the student should be able to

1. Understand the intelligent vision system used in automobiles
2. Understand the architecture of intelligent transportation system
3. Understand adaptive control techniques of an autonomous vehicle
4. Understand about the successful autonomous vehicle projects
5. Know the case studies of Autonomous vehicle

Hybrid and Electrical Vehicle					
Course code	OEC-ME-452G				
Category	Open Elective Course				
Course title	Hybrid and Electrical Vehicle				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Objectives of the course:

The objective of this course are:

1. Provide an insight into how electric vehicle operate
2. Demonstrate the functional requirements of Battery management system in detail.
3. Demonstrate how Electric and Hybrid Vehicle vary as per design requirements.
4. Perform the detailed analysis on the drives and driveline.
5. Selection of the appropriate drive and driveline system for the different cases.

Unit-I

Electric Vehicle Propulsion and Energy Sources: Basic concepts and problems concerning the electrification in Mobility, Functional components in an electric andhybrid vehicle, Vehicle Mechanics – Kinetics, Vehicle Mechanics – Dynamics &Roadway Fundamentals, Propulsion System Design - Force VelocityCharacteristics,Calculation Of Tractive Power And EnergyRequired, Electric Vehicle Power Source – BatteryCapacity, Battery Construction and Types State of Charge and Discharge , Calculation of Specific Energy and SpecificPower &Ragone Plot RelationshipBattery Modeling - Run Time BatteryModel, First Principle Model, Battery Management System- SOC Measurement, Battery Cell Balancing.Traction Batteries - Nickel Metal Hydride Battery, Li-Ion, Li-Polymer Battery.

Unit-II

Electric Vehicle Powerplant And Drives : Basic concepts of electric vehicle powerplant, Power and Torque plot, Construction of Induction Machines,Operating cycle and application in traction, Construction of Permanent MagnetMachines, Construction of Switch ReluctanceMachines, Role of Power Electronic ConvertersDC/DCConverters, Description of Buck Boost Converter Isolated DC/DC Converter, Functional Requirements and Operatinglimits, Two Quadrant Chopper Switching Modes, AC Drives- PWM , Current Control Method, Role of Switch Reluctance Machine Drives, Voltage Control, Current Control

Unit-III

Hybrid and Electric Drivetrains : Functional requirements of Hybrid Vehicle, Operational difference between the FullyElectric, Hybrid and Mild Hybrid, Topological Phenomena and SocialImportance of e-

mobility, Role of modern drivetrain and theconversion efficiency and powerconsumption, Description of Hybrid Traction, Description of Electric Traction. Topological Optimization for HybridTraction Topological Optimization for ElectricTraction, Power Flow Control & Energy Efficiency Analysis, Configuration and Control of DC MotorDrives, Induction Motor Drive. Permanent Magnet Motor Drives, SwitchReluctance Motor, Drives, Drive System Efficiency.

Unit-IV

Electric and Hybrid Vehicle Design: Design perspectives of Hybrid vehicle, Power plant energy distribution, Matching the Electric Machine and theInternal Combustion Engine, Parameter optimization – IC Engine, Position and Types of arrangements, Parameter optimization – Motor Position and Types of arrangements, Sizing of Propulsion Motor , Power Electronics & Drive System
Selection of Energy Storage Technology Topological Optimization, Communications & Supporting Subsystem, Energy Management Strategies in Hybrid, Vehicles- Classification,Comparison, Implementation

Electric And Hybrid Vehicles Case Studies: Parallel Hybrid, Series Hybrid -ChargeSustaining, Parallel Hybrid, Series Hybrid –ChargeDepleting, Hybrid Vehicle Case Study –Toyota Prius, Honda Insight, Chevrolet Volt; 42 V System for Traction Applications, Lightly Hybridized Vehicles and Low
Voltage System; Electric Vehicle Case Study - GM EV1,Nissan Leaf, Mitsubishi Miev;Hybrid Electric Heavy-Duty Vehicles, FuelCell Heavy DutyVehicles

Reference Books:

1. Iqbal Husain, "Eclectic and Hybrid vehicles Design Fundamentals" , CRC Press, second edition 2013, ISBN 9781439811757
2. James Larminie, John Lowry, "Electric vehicle technology Explained" second Edition, Wiley 2012, ISBN-13: 9781119942733
3. Ali Emadi, "Hand book of Automotive Power Elect ronics and Motor Drives", CRC Press 2005, ISBN 9780824723613.
4. Ali Emadi, Mehrdad Ehsani, John M. Muller, "Vehicular Electric Power Systems" Marcel Dekker, Inc., 2004

Course Outcomes:

After successfully completing the course the student should be able to

1. Learn the basic concepts of electric vehicle technology and electric vehicles.
2. Develop and analyze hybrid and electric drive trains.
3. Interpret various vehicle power sources in hybrid vehicle technology
4. Analyze data to determine appropriate design calculations of hybrid system under study.
5. Apply the concepts in sizing the electric motors