

Indira Gandhi University, Meerpur Rewari



Syllabus for B.Tech. – IVth Year (Semester VII and VIII)

(For Computer Science & Engineering-Artificial Intelligence & Machine Learning)

Session–w.e.f. 2026-2027

COURSE CODE AND DEFINITIONS

CourseCode	Definitions
L	Lecture
T	Tutorial
P	Practical
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences including Management courses
PCC	Professional Core Courses
PEC	Professional Elective Courses
LC	Laboratory Courses
MC	Mandatory Courses
PT	Practical Training
S	Seminar

General Notes:

1. Students will be allowed to use nonprogrammable scientific calculator. However, sharing of calculators will not be permitted in the examination.
2. Students will be permitted to opt for any elective course run by the department. However, the department shall offer those electives for which they have expertise. The choice of the students for any elective shall not be binding for the department to offer if the department does not have expertise. To run the elective course a minimum of 1/3rd students of the class should opt for it.

Indira Gandhi University, Meerpur, Rewari
B.Tech.(Artificial Intelligence & Machine Learning)
B.Tech. (Computer Science and Engineering-Artificial Intelligence & Machine Learning)
Scheme of Studies/Examination w.e.f. 2026-27
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-401 Common with CSE (DS)	Deep Learning	3	0	0	3	3	25	75		100	3
2.	Refer to Annexure-IV	Professional Elective-IV	3	0	0	3	3	25	75		100	3
3.	Refer to Annexure-V	Professional Elective-V	3	0	0	3	3	25	75		100	3
4	PCC-AI-408	Decision Support & Intelligent System	3	0	0	3	3	25	75		100	3
5.	PCC-AI-403	Applied Machine Learning	3	0	0	3	3	25	75	-	100	3
6.	LC-AI-443 Common with CSE (DS)	Deep Learning Lab	0	0	2	2	1	25	-	25	50	3
7.	LC-AI-445	Applied Machine Learning Lab	0	0	2	2	1	25	-	25	50	3
8	PT-CSE-425 (Common with CSE)	Practical Training-II	0	0	0	1	-	-	-	-	-	-
Total			15	-	4	20	17	175	375	50	600	

NOTE

PT-CSE-425: 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 (PT-CSE-425)

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

Annexure-IV
Professional Elective Courses-IV
(Choose Professional Elective Courses)

	Professional Electives	
	Course Code	Course title
Professional Elective -IV	PEC-DS-405	Advanced Python Programming
	PEC-AI-405	Reinforcement Learning
	PEC-AI-418	Web Intelligence

Annexure-V
Professional Elective Courses-V
(Choose Professional Elective Courses)
(Same as B.Tech CSE Data Science)

Professional Elective–V	PEC-AI-406	Recommender Systems
	PEC-AI-410	Intelligent Robots and Drone Technology
	PEC-AI-411	Artificial Intelligence for Cyber security
	PEC-DS-406	Image and Video Analytics

DeepLearning					
Course code	PCC-AI-401				
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.

COURSEOBJECTIVES:

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 local minima, Heuristics for faster training, Nestors accelerated gradient descent, Regularization, Dropout. Convolutional Neural Networks: Architectures, convolution / pooling layers, normalization, sequence modeling, applications.

Unit-II

Recurrent Neural Networks: 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 and memory models. Dynamic memory networks.

Unit-III

Applications of Deep Learning to Computer Vision: Image segmentation, object detection, automatic image captioning, Image generation with Generative adversarial networks, video to text with LSTM models, Attention models for computer vision tasks.

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

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

Unit-IV

Applications in word similarity, Analogy reasoning: Named Entity Recognition, Opinion Mining using Recurrent Neural Networks: Parsing and Sentiment Analysis using Recursive Neural Networks: **Sentence**

Classification using Convolutional Neural Networks: Dialogue Generation 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. Good fellow, 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* from CS229
6. Jason Brownlee, "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

Decision Support and Intelligent System				
Course code	PCC-AI-408			
Category	Professional Core Course			
Course title	Decision Support and Intelligent System			
Scheme and Credits	L	T	P	Credits
	3	0	0	3
Classwork	25Marks			
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 for Decision Making, An Early Framework for Computerized Decision Support, The Concept of Decision Support Systems, A Framework for Business Intelligence, Business Analytics Overview, Brief Introduction to Big Data Analytics, Click stream 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 for decision 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, Pair wise comparisons.

Unit-III

Basic Concepts of Neural Networks , Developing Neural Network Based Systems, Illuminating the Black Box of ANN with Sensitivity, Support Vector Machines, A Process Based 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, Dursun Delen, Efraim Turban, J.E. Aronson, Ting-Peng Liang, David King, "Business Intelligence and Analytics: System for Decision Support", 10th Edition, Pearson Global Edition, 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

Applied Machine Learning				
Course code	PCC-AI-403			
Category	Professional Core Course			
Course title	Applied Machine Learning			
Scheme and Credits	L	T	P	Credits
	3	0	0	3
Class work	25Marks			
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. 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 data Analyze the results, Building a text classifier, Analyzing the sentiment of a sentence, Implement the sentiment analysis of a sentence, Identifying patterns in text using topic modeling, 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 custom parameters, Generate the time axis,

Unit-II

Speech Recognition- Synthesizing music, Construct the audio sample -amplitude and 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 Sequential Data – 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 series data, Correlation coefficients, Plotting and understanding correlations, Building Hidden Markov Models for sequential data, Prepare the Time Series data, Train Gaussian HMM, Visualizing the model, Building Conditional Random Fields for sequential 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 feature detector, Visualize keypoints on the input image, Creating features using visual codebook and 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 a webcam, Resizing and Scaling, Building a face detector using Haar cascades, determine the location of a face in the video 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 Components Analysis, PCA in face recognition systems, Convert the dataset from a five- dimensional set to a two-dimensional set, 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 Joshi and co, 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. Michael Bowles, Machine Learning in Python, 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

Applied Machine Learning Lab				
Course code	LC-AI-445			
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. A minimum 15 Lab activities will be carried out from the offered course contents of Machine Learning in the semester.

Deep Learning Lab				
Course code	LC-AI-443			
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 minimum 15 Lab activities will be carried out from the offered course contents of Deep 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.

Practical Training-II					
Course code	PT-CSE-425				
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-II 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

Professional Electives

Advanced Python Programming				
Course code	PEC-DS-405			
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 Pre processing 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 – Lambda 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 – MATPLOTLIB

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 SQL Alchemy, 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 multi threading 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-405			
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 related fields and with different branches of machine learning. **Markov Decision Process:** Introduction to RL terminology, Markov property, Markov chains, Markov reward process (MRP), Introduction to Markov decision process (MDP), state and action value functions.

Unit-II

Prediction and Control by Dynamic Programming: Overview of dynamic programming for MDP, definition and formulation of planning in MDPs, principle of optimality, iterative policy evaluation, policy iteration, value iteration, Banach fixed 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 Carlo Methods 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, Importance sampling. **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 their variants.

Unit-IV

Function Approximation Methods and Deep Reinforcement Learning: Revisiting risk minimization, gradient descent from Machine Learning, Gradient MC and Semi-gradient TD (0) algorithms, Eligibility trace for function approximation, after states, Control with function approximation, Least squares, Experience replay in deep Q-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 chat bots, 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 implementing code common RL algorithms

Web Intelligence				
Course code	PEC-AI-418			
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: What applications can benefit from web intelligence, WisdomWeb, 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, RDF ferret-Full Text Search and RDF Querying, Onto Share-Community support, Onto Edit-Ontology Development, OntoView-Change Management for Ontologies, Sesame-Repositories for Ontologies and Data, CORPORIUM- Information Extraction

Unit-III

DataMiningTechniques-Classification,ClusteringandAssociation,Associations,WebUsageMining-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 Web Topology, PageRank Algorithm, Hyperlink-Induced Topic Search (HITS), Random Walks on the Web;

Unit-IV

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

ReferencesBooks:

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 from Springer link)
5. Manning, Raghavan and Schuetze: Introduction to Information Retrieval, Cambridge University Press, 2008 (book available online)
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 abilityto 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

Recommender Systems					
Coursecode	PEC-AI-406				
Category	Professional Elective Course				
Coursetitle	Recommender System				
SchemeandCredits	L	T	P	Credits	
	3	0	0	3	
Classwork	25 Marks				
Exam	75 Marks				
Total	100 Marks				
DurationofExam	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 recommender systems
4. To provide the students an ability to classify the different recommender systems solutions
5. To build up the capability to develop are commender systems solution

Unit-I

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

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

Unit-II

Content-based recommendation: High level architecture of content-based systems, Advantages and drawbacks of content-based filtering, Item profiles, discovering features of documents, obtaining item features from tags, representing item profiles, Methods for learning user profiles, Similarity based retrieval, Classification algorithms.

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

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

Unit-III

Evaluating Recommender System: Introduction, General properties of evaluation research, Evaluation designs, Evaluation on historical datasets, Error metrics, Decision-Support metrics, User- Centred metrics. **Context-Sensitive Recommender Systems** - 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 :Multi dimensional Models for Social Context -Network-Centric and Trust-Centric Methods – Use Interaction 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

Intelligent Robots and Drone Technology					
Coursecode	PEC-AI-410				
Category	Professional Elective Course				
Coursetitle	Intelligent Robots and Drone Technology				
SchemeandCredits	L	T	P	Credits	
	3	0	0	3	
Classwork	25 Marks				
Exam	75 Marks				
Total	100 Marks				
DurationofExam	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. Design 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. Design and simulation of any robotic device

Unit-I

Robotics Paradigm: Machine intelligence, History of Robotics, Types of Robots, Setting up your Robot: Technical requirements, 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 Control system 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: The problem Who, What, When and Where; Story boards: 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 Air frame, Choosing Between Commercial Options, Maker Beam Airframe – Parts and Steps.

Building a Quadcopter II : Motors and Props, Choose Your Motors, Out runner Versus In runner, 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. Well fleet 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-411			
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 Security Solutions-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 Wire shark, 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 with Time 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 Black listing – Drive by download URL- Command and Control URLs – Phishing URLs – Using Heuristics 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 – Re CAPTCHA – 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–Ransome ware–Root kit–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 – AI based 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 detectspam–Laplacesmoothing–FeaturizationTechniquetocovertextbasedemailstonumeric 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. Cyber security 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.

Image and Video Analytics				
Course code	PEC-DS-406			
Category	Professional Elective Course			
Course title	Image and Video Analytics			
Scheme and Credits	L	T	P	Credits
	3	0	0	3
Class work	25Marks			
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 and Segmentations: Colour models and Transformations, image and video Segmentation, image and video denoising, image and Video enhancement- Image and Video compression;

Unit-IV

Detection and Classification Object detection and recognition in image and video, texture models Image and video classification 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 Szeliski, *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.

B.Tech.(Computer Science & Engineering-Artificial Intelligence & Machine Learning)
Scheme of Studies/Examination
w.e.f. 2026-2027
Semester 8th

Sr. No.	Category	Course Code	Course Title	Hours per week			Total Contact Hrs. per week	Credit	Examination Schedule(Marks)				Duration of Exam (Hours) L
				L	T	P			Internal Assessment	Theory	Practical	Total	
1	Professional Core Course	INTPR-CSE-402	Industrial Training/ Institutional Project	0	0	6	6	10	200	-	300	500	3

2 Hours per week per batch for one teacher and batch size will be decided by the HOD/Chairperson of the department.

Procedure for Examination and continuous Assessment

(A) External Exam Marks

- | | |
|-----------------------|-----------|
| 1. Project Evaluation | 100 Marks |
| 2. Project Seminar | 100 Marks |
| 3. Project Viva | 100 Marks |

(B) Continuous Assessment Marks

- | | |
|---|-----------|
| 1. Assessment by Internal Examiner and Viva
(Before the Committee Constituted by Chairman of the Department) | 150 Marks |
| 2. Assessment by Industrial Guide/ Chairperson | 50 Marks |

NOTE: It is Optional. A student can earn at most 6 credits during the duration of the 8th semester subject to the passing of at least two MOOC/NPTEL courses (carrying minimum 2/3 credits). The MOOC/NPTEL chosen by the student should not be on offer/scheme of the degree. These credits will be considered in the Final Mark sheet of the students.