

Indira Gandhi University, Meerpur, Rewari



Syllabus for B.Tech. – IVth Year
(Semester VII and VIII)
(For Computer Science & Engineering-Data Science)

Session–w.e.f.2026-2027

COURSE CODE AND DEFINITIONS

Course Code	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 non programmable 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.(Computer Science and Engineering- Data Science)
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 (Hrs)
			L	T	P			Internal Assessment	Theory	Practical	Total	
1	PCC-AI-401	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-404	Social Network Analysis	3	0	0	3	3	25	75	-	100	3
5	PCC-AI-408	Decision Support & Intelligent System	3	0	0	3	3	25	75		100	3
6	LC-AI-441	Deep Learning Lab	0	0	2	2	1	25	-	25	50	3
7	LC-DS-443	Advanced Programming Lab-III	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	0	04	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

Note-Students will have to choose one each from Professional Elective-IV

	Course Code	Course title
Professional Elective-IV	PEC-DS-403	Big Data Tools and Techniques
	PEC-DS-405	Advanced Python Programming
	PEC-AI-403	Applied Machine Learning

Annexure-V

Professional Elective Courses-V

Note-Students will have to choose one each from Professional Elective-V

(Same as B.Tech CSE AI & ML)

	Course Code	Course title
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

Deep Learning					
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	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.

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 gradie 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: Auto encoders, 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. Goodfellow, Y. Bengio and A. Courville *Deep Learning(1e)*, MITPress,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 frame work for supervised learning
3. Deal with Convolution Neural Networks
4. Analyze various types efficient data encoders
5. Apply various network models in deep learning

Social Network Analysis					
Course code	PCC-AI-404				
Category	Professional Core Course				
Course title	Social Network Analysis				
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.

COURSEOBJECTIVES:

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 Tie Strength, Tie Strength and Network Structure, Tie Strength and Network Propagation, Link Prediction, Entity Resolution.

Link Prediction: Case Study Friend Recommendation, Introduction to Community Discovery, Communities in Context, Quality Functions;

Unit-III

Algorithms: The Kernighan-Linalgorithm, Agglomerative Algorithms, Spectral Algorithms, Multi-level Graph Partitioning, Markov Clustering, Other Approaches.

Unit-IV

Introduction to Social Influence: Influence Related Statistics, Social Similarity and Influence, 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:

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

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

Deep Learning Lab				
Course code	LC-AI-441			
Category	Laboratory Course			
Course title	Deep Learning Lab			
Scheme and Credits	L	T	P	Credits
	0	0	2	1
Classwork	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 etc.

Advanced Programming Lab-III					
Course code	LC-DS-443				
Category	Laboratory Course				
Course title	Advanced Programming Lab-III				
Scheme and Credits	L	T	P	Credits	
	0	0	2	1	
Branches (B. Tech.)	Computer Science and Engineering				
Classwork	25 Marks				
Exam	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

NOTE:

A minimum 15 Lab activities related to the course contents of Professional Electives (PE-IV of 7th Sem) can be designed and developed by the subject faculty using suitable Python or any available Open Source tools/ software.

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

Big Data Tools & Techniques				
Course code	PEC-DS-403			
Category	Professional Elective Course			
Course title	Big Data Tools & Techniques			
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. Gain knowledge about the various tools and techniques used in big data analytics
2. Learn the fundamentals of Hadoop and the related technologies
3. Understand the basics of development of applications using Map Reduce, HDFS, YARN
4. Learn the basics of Pig, Hive and Sqoop
5. Learn the basics of Apache Spark, Flink and understand the importance of NoSQL databases
6. Learn about Enterprise Data Science and data visualization tools

Detailed Course

Unit-I

Overview of Big Data Analytics, Introduction to data analytics and big data, Big data mining, Technical elements of the Big Data platform, Analytics Toolkit, Components of the analytics toolkit, Distributed and Parallel Computing for Big Data, Cloud computing and Big Data, In-Memory Computing Technology for Big Data Fundamentals of Hadoop, Hadoop Ecosystem, The core modules of Hadoop, Introduction to Hadoop Map Reduce, Introduction to Hadoop YARN

Unit-II

MapReduce - Analyzing data with Unix tools and Hadoop, Scaling Out – Data Flow, Combiner Functions, Hadoop Streaming, HDFS, Hadoop file systems, Java Interface to Hadoop, YARN, Job Scheduling, Hadoop I/O, Data Integrity, Compression, Serialization, File based Data Structures, Developing a Map Reduce Application

Unit-III

Setting up a Hadoop cluster, Cluster specification and setup, Hadoop configuration, YARN configuration, Introduction to Pig, Installing and running pig, Basics of Pig Latin, Introduction to Hive
Installing and running Hive , Introduction to Hive QL, Introduction to Zookeeper, Installing and running Zookeeper, The Zookeeper Service, Flume Architecture, Introduction to Sqoop; Introducing Oozie, Apache Spark, Limitations of Hadoop and overcoming the limitations, Core components and architecture of Spark; Introduction to Apache Flink, Installing Flink, Batch analytics using Flink;

Unit-IV

Big Data Mining with NoSQL, Why No SQL? NoSQL databases; Introduction to H Base, Introduction to Mongo DB, Cassandra.

Enterprise Data Science- Overview, Data Science Solutions in the enterprise, Visualizing Big Data, Enterprise data science – Machine Learning and AI, Enterprise Infrastructure solutions, Using Python and R for visualization, Big Data Visualization Tools, Data Visualization with Tableau, Case Studies: Hadoop, Spark, NoSQL

References Books:

1. Tom White, Hadoop: The Definitive Guide, 3rd Edition, O'Reilly, 2012.
2. Sridhar Alla, Big Data Analytics with Hadoop3, Packt, 2018.
3. Nataraj Dasgupta, Practical Big Data Analytics, Packt, 2018.
4. DT Editorial Services, Big Data: Black Book, 2016.

Course Outcomes:

After successfully completing the course the student should be able to

1. Use the various tools and techniques in big data analytics
2. Apply Hadoop and related technologies to big data analytics
3. Apply Map Reduce, HDFS and YARN develop big data applications
4. Develop applications using Pig, Hive and Sqoop
5. Apply Apache Spark and Flink to applications and understand the importance of NoSQL databases
6. Understand the applications of Enterprise Data Science and data visualization tools

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
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. 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 – Lambda Functions and Parallel processing – MAPS – Filtering – Iter tools – 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-ReillyMedia,2016
3. Zed A Shaw, Learn Python the Hard Way-Avery 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 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

Applied Machine Learning				
Course code	PEC-AI-403			
Category	Professional Elective Course			
Course title	Applied Machine Learning			
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. 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 categorizing words, Sequential tagging, Back off tagging, Creating features from text data- Stemming, Lemmatizing , Bagging using ngr and omforests, 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 key points 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 web cam, Resizing and Scaling, Building a face detector using Haarcascades , 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 to picmodeling
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

Recommender Systems					
Course code	PEC-AI-406				
Category	Professional Elective Course				
Course title	Recommender System				
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 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 recommender 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: Multidimensional 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. Shapiraand 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. U K: 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				
Course code	PEC-AI-410			
Category	Professional Elective Course			
Course title	Intelligent Robots and Drone Technology			
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 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 – Quad copter, 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. 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-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	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. 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 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 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 Duaand 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

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 demonising, 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 and Engineering- Data Science)
Scheme of Studies/Examination Semester 8th
w.e.f. 2026-2027

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-CSDS-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 atmost 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.