P D A College of Engineering

B.E. in Artificial Intelligence and Machine Learning

Scheme of Teaching and Examinations 2022

Outcome Based Education(OBE) and Choice Based Credit System(CBCS)

VII SEMESTER (Swappable VII and VIII SEMESTER)

Sl .No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours/Week				Examination				Credits
					Theor	Tutorial	Practical/Dra	Self-Study	Duration in	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	IPCC	22AI71	Big Data Analytics	TD- Respective Dept. PSB- Respective Dept.	3	0	2		03	50	50	100	4
2	IPCC	22AI72	Natural Language Processing	TD- Respective Dept. PSB- Respective Dept.	3	0	2		03	50	50	100	4
3	PCC	22AI73	Generative AI	TD-Respective Dept. PSB- Respective Dept.	4	0	0		03	50	50	100	4
4	PEC	22AI74X	**Professional Elective-III**	TD-Respective Dept. PSB- Respective Dept.	3	0	0		03	50	50	100	3
5	OEC	22AIOE75X	**Open Elective-II**	TD-Respective Dept. PSB- Respective Dept.	3	0	0		03	50	50	100	3
6	PROJ	22AIP76	**Major Project Phase-II**	TD-Respective Dept. PSB- Respective Dept.	0	0	12		03	50	50	100	6
				Total	16	0	16			**300**	**300**	**600**	**24**

Professional Elective Course

22AI741	Computer Networks	22AI743	Augmented Reality and Virtual Reality
22AI742	Machine Learning Operations	22AI744	Deep Learning and Reinforcement Learning

Open Elective Course

22AIOE751	Software Engineering and Project Management		

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **PEC**: Professional Elective Course, **OEC**: Open Elective Course PR: Project Work, **L:**Lecture,**T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. **TD-** Teaching Department, **PSB**: Paper Setting department, **OEC**: Open Elective Course, **PEC**: Professional Elective Course. **PROJ**: Project work

Note: VII and VIII semesters of IV years of the program swapping facility

Institutions can swap the VII and VIII Semester Schemes of Teaching and Examinations to accommodate research internships/industry internships after the VI semester

P D A College of Engineering

B.E. in Artificial Intelligence and Machine Learning

Scheme of Teaching and Examinations 2022

Outcome Based Education(OBE) and Choice Based Credit System(CBCS)

VIII SEMESTER (Swappable VII and VIII SEMESTER)

Sl .No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board(PSB)	Teaching Hours/Week				Examination				Credits
					Theor	Tutorial	Practical/Dra	Self-Study	Duration in	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	PEC	22AI81X	**Professional Elective-IV (Online Courses) – NPTEL**	TD-Respective Dept. PSB- Respective Dept.	3	0	0		03	50	50	100	3
2	OEC	22AIOE82X	**Open Elective-III (Online Courses)**	TD-Respective Dept. PSB- Respective Dept.	3	0	0		03	50	50	100	3
3	INT	22AIINT83	**Internship(Industry/Research)(14-20weeks)**	TD-Respective Dept. PSB- Respective Dept.	0	0	12		03	100		100	10
				Total	06	00	12			**200**	**100**	**300**	**16**

Professional Elective Courses (Online courses)

22AI811	Cloud Computing	22AI814	Computer Vision
22AI812	Ethical Hacking	22AI815	Introduction to Large Language Models (LLMs)
22AI813	Privacy and Security in Social Media	22AI816	Introduction to Internet of Things

Open Elective Courses(Online Courses)

22AIOE821	Patent Law for Engineers and Scientists	22AIOE824	Environmental Science
22AIOE822	Soft Skills	22AIOE825	Project Planning and Control
22AIOE823	Project Management: Planning, Execution, Evaluation and Control	22AIOE826	Wastewater Treatment and Recycling

L:Lecture, **T**:Tutorial, **P**:Practical **S=SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation.**TD-**Teaching Department, **PSB**: Paper Setting department, **OEC**: Open Elective Course, **PEC**: Professional Elective Course. **PROJ**: Project work, **INT**: Industry Internship/Research Internship/Rural Internship

Professional Elective/Open Elective Course: These are the ONLINE courses suggested by the respective Board of Studies

Online Professional Course: The students need to register (anywhere between VI to VIII Semesters) NPTEL Course of 12 weeks duration (3 Credits course) and should pass the examination. The NPTEL Courses relevant to the program and need to be identified by the department and same is to be informed to the students.

Online Open Elective Course: The students need to register (anywhere between VI to VIII Semesters) NPTEL Course of 12 weeks duration (3 Credits course) and should pass the examination. The NPTEL Courses that enables skill enhancements and job opportunities need to be suggested by the department and same is to be informed to the students.

Big Data Analytics		
Course Code	22AI71	CIE: 50
Credits	04	SEE: 50
Course Type	IPCC	
Number of Lecture Hours/Week (L-T-P)	3-0-2	Total Marks:100
Total Number of Lecture Hours	52 Hours (40:Theory+12:Practical)	SEE Hours: 03

Course Objectives:

- To understand the concepts of big data and hadoop
- To understand MapReduce concepts
- To perform data analysis with pig tool and to perform high volume ingestion into Hadoop of event based data
- To create and load data into HIVE tables
- To create resilient distributed datasets

Modules	Teaching Hours
Module-I Big Data: characteristics of big data, Applications of Big Data, comparison with other systems, data analysis with Hadoop, scaling out, data flow, combiner functions, Hadoop streaming. HDFS, Design of HDFS, HDFS concepts-blocks, name node and data node, clock caching, HDFS federation, HDFS high availability, failover and fencing, the command line interface, Basic file system operations, Hadoop filesystems, Data flow, Anatomy of a file write, Parallel Copying with distcp, Keeping an HDFS Cluster Balanced	08
Module-II YARN: Anatomy of a YARN Application Run, resource requests, application lifespan, YARN Compared to MapReduce 1, Scheduling in YARN, scheduler options, Anatomy of a MapReduce Job Run.	08
Module-III Pig: Comparison with Databases, Pig Latin-Structure, Statements, Expressions, Types, Schemas, Functions, Macros, User-Defined Functions- A Filter UDF, An Eval UDF, A Load UDF; Data Processing Operators- Loading and Storing Data, Filtering Data, Grouping and Joining Data, Sorting Data, Combining and Splitting Data, Pig in Practice Parallelism, Anonymous Relations, Parameter Substitution Flume: working with flume, Transactions and Reliability, The HDFS Sink, Fan Out, Distribution.	08
Module-IV Hive: HiveQL- Data Types, Operators and Functions, Tables-Managed Tables and External Tables, Partitions and Buckets, Storage Formats, Importing Data, Altering Tables, Dropping Tables, Querying Data- Sorting and Aggregating, MapReduce Scripts, Joins, Sub queries, Views User-Defined Functions, Partitioning -static and dynamic Sqoop: Sqoop Connectors, import, generated code, Working with Imported Data, Exports	08

Module-V Spark: Resilient Distributed Datasets- Creation, Transformations and Actions, Persistence, Serialization, Shared Variables, Anatomy of a Spark Job Run--Job Submission, DAG Construction, Task Scheduling, Task Execution; Executors and Cluster Managers HBase: HBasics, Concepts, HBase Versus RDBMS, Building an Online Query Application	08

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 20 marks.
- Each full question will have sub questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

Tom White, "Hadoop: The Definitive Guide: Storage and Analysis at Internet Scale", 4/e, O'Reilly

Reference Books:

Seema Acharya, Subhashini Chellappan, "Big Data and Analytics", Wiley India Pvt. Ltd

Course outcomes: On completion of the course, the student will have the ability to:

Course Code	CO#	Course Outcome(CO)
22AI71	CO1	Work with hadoop distributed file system
	CO2	Develop map reduce based applications
	CO3	Perform data analysis using pig tool
	CO4	To use hive tool for data analysis
	CO5	Big Data processing using SPARK

Practical Component of IPCC

List of Experiments	
1	Implement the following file management tasks in Hadoop: a. Adding files and directories b. Retrieving files c. Deleting files Hint: A typical Hadoop workflow creates data files (such as log files) elsewhere and copies them into HTFS using one of the above command line utilities.
2	Develop a MapReduce program to implement matrix multiplication.
3	Develop a MapReduce program that mines whether data and displays appropriate messages indicating the weather conditions of the

	day.
4	Develop a MapReduce program to find the tags associated with each movie by analyzing movie lens data.
5	Implement Functions: Count – Sort – Limit – Skip – Aggregate using MongoDB.
6	Write Pig Latin scripts to sort, group, join , project, and filter the data.
7	Use Hive to create, alter, and drop databases, tables, views, functions and indexes.
8	Implement a word count program in Hadoop and Spark.
9	Use CDH (Cloudera Distribution for Hadoop) and HUE (Hadoop User Interface) to analyze data and generate reports for sample datasets.

Natural Language Processing		
Course Code	22AI72	CIE: 50
Credits	04	SEE: 50
Course Type	IPCC	
Number of Lecture Hours/Week (L-T-P)	3-0-2	Total Marks:100
Total Number of Lecture Hours	52 Hours (40:Theory+12:Practical)	SEE Hours: 03

Course Objectives:

- Learn the importance of natural language modeling
- Understand the applications of natural language processing
- Study spelling, error detection and correction methods and parsing techniques in NLP
- Illustrate the information retrieval models in natural language processing

Modules	Teaching Hours
Module-I Introduction: What is Natural Language Processing? Origins of NLP, Language and Knowledge, The Challenges of NLP, Language and Grammar, Processing Indian Languages, NLP Applications. Language Modeling: Statistical Language Model - N-gram model (unigram, bigram), Paninion Framework, Karaka theory.	08
Module-II Word Level Analysis: Regular Expressions, Finite-State Automata, Morphological Parsing, Spelling Error Detection and Correction, Words and Word Classes, Part-of Speech Tagging. Syntactic Analysis: Context-Free Grammar, Constituency, Top-down and Bottom-up Parsing, CYK Parsing.	08
Module-III Naive Bayes, Text Classification and Sentiment: Naive Bayes Classifiers, Training the Naive Bayes Classifier, Worked Example, Optimizing for Sentiment Analysis, Naive Bayes for Other Text Classification Tasks, Naive Bayes as a Language Model.	08
Module-IV Information Retrieval: Design Features of Information Retrieval Systems, Information Retrieval Models - Classical, Non-classical, Alternative Models of Information Retrieval - Custer model, Fuzzy model, LSTM model, Major Issues in Information Retrieval. Lexical Resources: WordNet, FrameNet, Stemmers, Parts-of-Speech Tagger, Research Corpora.	08
Module-V Machine Translation: Language Divergences and Typology, Machine Translation using Encoder-Decoder, Details of the Encoder-Decoder Model, Translating in Low-Resource Situations, MT Evaluation, Bias and Ethical Issues.	08

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 20 marks.
- Each full question will have sub questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Tanveer Siddiqui, U.S. Tiwary, "Natural Language Processing and Information Retrieval", Oxford University Press.
2. Daniel Jurafsky, James H. Martin, "Speech and Language Processing, An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition", Pearson Education, 2023.

Reference Books:

1. Akshay Kulkarni, Adarsha Shivananda, "Natural Language Processing Recipes - Unlocking Text Data with Machine Learning and Deep Learning using Python", Apress, 2019.
2. T V Geetha, "Understanding Natural Language Processing – Machine Learning and Deep Learning Perspectives", Pearson, 2024.
3. Gerald J. Kowalski and Mark.T. Maybury, "Information Storage and Retrieval systems", Kluwer Academic Publishers

Course outcomes: On completion of the course, the student will have the ability to:

Course Code	CO#	Course Outcome(CO)
22AI73	CO1	Apply the fundamental concept of NLP, grammar-based language model and statistical-based language model
	CO2	Explain morphological analysis and different parsing approaches.
	CO3	Develop the Naïve Bayes classifier and sentiment analysis for Natural language problems and text classifications.
	CO4	Apply the concepts of information retrieval, lexical semantics, lexical dictionaries.
	CO5	Identify the Machine Translation applications of NLP using Encode and Decoder.

Practical Component of IPCC

List of Experiments	
01	Write a Python program for the following preprocessing of text in NLP: ● Tokenization ● Filtration ● Script Validation ● Stop Word Removal ● Stemming
02	Demonstrate the N-gram modeling to analyze and establish the probability distribution across sentences and explore the utilization of unigrams, bigrams, and trigrams in diverse English sentences to illustrate the impact of varying n-gram orders on the calculated probabilities

03	Investigate the Minimum Edit Distance (MED) algorithm and its application in string comparison and the goal is to understand how the algorithm efficiently computes the minimum number of edit operations required to transform one string into another. ● Test the algorithm on strings with different type of variations (e.g., typos, substitutions, insertions, deletions) ● Evaluate its adaptability to different types of input variations
04	Write a program to implement top-down and bottom-up parser using appropriate context free grammar.
05	Given the following short movie reviews, each labeled with a genre, either comedy or action: ● fun, couple, love, love comedy ● fast, furious, shoot action ● couple, fly, fast, fun, fun comedy ● furious, shoot, shoot, fun action ● fly, fast, shoot, love action and A new document D: fast, couple, shoot, fly Compute the most likely class for D. Assume a Naive Bayes classifier and use add-1 smoothing for the likelihoods.
06	Demonstrate the following using appropriate programming tool which illustrates the use of information retrieval in NLP: ● Create and use your own corpora (plaintext, categorical) ● Study Conditional frequency distributions ● Write a program to find the most frequent noun tags ● Map Words to Properties Using Python Dictionaries
07	Write a Python program to find synonyms and antonyms of the word "active" using WordNet
08	Implement the machine translation application of NLP where it needs to train a machine translation model for a language with limited parallel corpora. Investigate and incorporate techniques to improve performance in low-resource scenarios.

Generative AI		
Course Code	22AI73	CIE: 50
Credits	04	SEE: 50
Course Type	PCC	
Number of Lecture Hours/Week (L-T-P)	4-0-0	Total Marks:100
Total Number of Lecture Hours	52 Hours (Theory)	SEE Hours: 03

Course Objectives:

- To represent probabilistic distributions for Generative AI models.
- To explore Generative AI models like GANs, VAEs and Transformers.
- To discuss current trends and future directions in Generative AI research.
- Develop proficiency in Python and Tensroflow2 for preprocessing and cleaning data in Generative AI applications
- Evaluate real-world applications, challenges and emerging trends in Generative AI

Modules	Teaching Hours
Module-I Probability and Information Theory: Why Probability?, Random Variables, Probability Distributions, Marginal Probability, Conditional Probability, The Chain Rule of Conditional Probabilities, Independence and Conditional Independence, Expectation, Variance and Covariance, Common Probability Distributions, Useful Properties of Common Functions, Bayes' Rule, Technical Details of Continuous Variables, Information Theory, Structured Probabilistic Models .	11
Module-II Generative AI Applications: Applications in Various Fields : Art and Creativity, Image and Video Generation, Text Generation, Music Composition, Healthcare Finance. Real-world use cases and challenges in deploying generative AI models.	10
Module-III Introduction to Large Language Models: Overview of Generative AI and Large Language Models. Basics of attention mechanisms and Transformer architecture. Pre-training techniques and transfer learning strategies.	11
Module-IV Python and TensorFlow 2 in Generative AI: Overview of Python and TensorFlow 2, Preprocessing and cleaning data for Generative AI applications. Visualizing data distributions and patterns in Generative AI datasets. Introduction to TensorFlow's computation graph and eager execution.	10

Module-V Applications and Future Directions: Real-world applications of large language models. Challenges and limitations of current approaches. Emerging trends and future directions in Generative AI.	10

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 20 marks.
- Each full question will have sub questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Generative AI for Everyone: Understanding the Essentials and Applications of This Breakthrough Technology". Altaf Rehmani .
2. "Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville.
3. "Neural Networks and Deep Learning: A Textbook" by Charu C. Aggarwal.

Reference Books:

1. "Generative Adversarial Networks Cookbook: Over 100 recipes to build generative models using Python, TensorFlow, and Keras" by Josh Kalin.
2. “Generative AI in Software Development: Beyond the Limitations of Traditional Coding” Jesse Sprinter, 2024.

Course outcomes: On completion of the course, the student will have the ability to:

Course Code	CO#	Course Outcome(CO)
22AI741	CO1	To understand the basic notions of discrete and continuous probability.
	CO2	To understand the methods of statistical inference and the role that sampling distributions play in those methods.
	CO3	To be able to perform correct and meaningful statistical analyses of simple to moderate complexity.
	CO4	Apply generative models to generate new content and enhance existing data.
	CO5	Utilize generative AI techniques to solve complex problems in different domains

Computer Networks		
Course Code	22AI741	CIE: 50
Credits	03	SEE: 50
Course Type	PEC-III	
Number of Lecture Hours/Week (L-T-P)	4-0-0	Total Marks:100
Total Number of Lecture Hours	42 Hours	SEE Hours: 03

Course Objectives:

- To acquire knowledge of various Computer Network models, Topologies and Physical Layer.
- To study the duties and protocols of Data Link Layer.
- To study basics and applications of Wired Networks.
- To study the duties and protocols of Network Layer.
- To study the duties and protocols of Transport Layer and upper Layers.

Modules	Teaching Hours
Module-I **INTRODUCTION**: The OSI model & layers in OSI model, TCP/IP protocol suite, Addressing, Functions of Physical Layer, Transmission Media, Transmission impairments, Data rate and its limits, Performance measures, Concepts of Switching and Multiplexing.	08
Module-II **DATA LINK Layer**: Framing, Addressing, Flow & Error Control, Protocols for Noiseless & Noisy Channels, Piggybacking. **Multiple Accesses Protocols:** Random Access protocols, Controlled Access protocols and Channelization protocols.	10
Module-III **Wired LANs: Ethernet-**IEEE Standards, Standard Ethernet, Fast Ethernet, Gigabit Ethernet, and Comparison. Connecting Devices, Backbone Networks & Virtual LANs**.**	08
Module-IV **NETWORK LAYER:** Duties and Responsibilities- Logical Addressing- Classful and Classless Addressing, IPv4 protocol, IPv4 vsIPv6, Transition from IPv4 to IPv6, Routing- Unicast and Multicast Routing Protocols.	08

Module-V	
TRANSPORT LAYER: Duties-Addressing, Protocols-UDP, TCP, connection techniques. Overview of Upper Layer protocols. Overview of various social media platforms such as Facebook, Whatsapp, Twitter, Instagram.	08

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 20 marks.
- Each full question will have sub questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Data Communication & Networking, B.Forouzan, 4th Ed., TMH, 2006.
2. Computer Communication Networks, Andrew. S. Tanenbaum, 4th ED., PHI.

Reference Books:

Computer and Communication Networks, Nader Mir, Pearson Education,3rd Edition,2009.

Course outcomes: On completion of the course, the student will have the ability to:

Course Code	CO#	Course Outcome(CO)
22AI72	CO1	Identify the categories, Topologies and Network Models, and duties of Physical Layer
	CO2	Apply the concepts of Data Link Layer (DLL), functionalities and its protocols.
	CO3	Analyze the Ethernet structure and functioning of Wired LANs.
	CO4	Apply the concepts of Network Layer and its protocols and realize them.
	CO5	Apply the concepts of Transport Layer and its protocols, and Upper Layers.

Machine Learning Operations		
Course Code	22AI742	CIE: 50
Credits	03	SEE: 50
Course Type	PEC -III	
Number of Lecture Hours/Week (L-T-P)	3-0-0	Total Marks:100
Total Number of Lecture Hours	42 Hours (Theory)	SEE Hours: 03

Course Objectives:

- To enable students to learn the concepts related to Machine Learning Operations in the following topics
- To introduce students to the features, development and deployment of Machine Learning models.
- To develop the skills for solving practical problems.
- To enable students to pursue independent study and research in this field.

Modules	Teaching Hours
Module-I What and Why : Why Now and Challenges: Defining MLOps and Its Challenges - MLOps to Mitigate Risk - MLOps for Scale. People of MLOps: Subject Matter Experts - Data Scientists - Data Engineers - Software Engineers – DevOps - Model Risk Manager/Auditor - Machine Learning Architect	10
Module-II Features of MLOps and Developing a Model: Key MLOps Features: A Primer on Machine Learning - Model Development - Productionalization and Deployment – Monitoring - Iteration and Life Cycle - Governance. Developing Models: What Is a Machine Learning Model? - Data Exploration - Feature Engineering and Selection – Experimentation - Evaluating and Comparing Models - Version Management and Reproducibility.	08
Module-III Preparation and Deployment of Production Preparing for Production: Runtime Environments - Model Risk Evaluation - Quality Assurance for Machine Learning - Quality Assurance for Machine Learning - Key Testing Considerations - Reproducibility and Auditability - Machine Learning Security - Model Risk Mitigation.	08
Module-IV Deploying to Production: CI/CD Pipelines - Building ML Artifacts - Deployment Strategies – Containerization - Scaling Deployments - Requirements and Challenges. Feedback Loop: How Often Should Models Be Retrained? - Understanding Model Degradation - Drift Detection in Practice - The Feedback Loop.	08

Module-V	
Model Governance – Who decides what governance organization needs – Matching governance with Risk Level – Current regulations driving MLOps governance – Key elements of responsible AI – Template of MLOps Governance MLOPs in Practise: Consumer Credit Risk Management – Background: The business use case, Model Development, Model Bias Consideration, Prepare for Production, Deploy to Production, Closing Thoughts	08

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 20 marks.
- Each full question will have sub questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

Mark Treveil and the Dataiku Team- Introducing MLOps How to Scale Machine Learning in the Enterprise, O'Reilly Media, Inc., 1005 Gravenstein Highway North, Sebastopol, CA 95472 , 1st Edition ,2020,ISBN : 9781492083290

Reference Books:

1. Noah Gift and Alfredo Deza, Practical MLOps, O'Reilly Media, Inc., 1005 Gravenstein Highway North, Sebastopol, CA 95472 , 1st Edition, 2021, ISBN: 9781098103019
2. David Sweenor, Steven Hillion, Dan Rope, Dev Kannabiran, Thomas Hill, Michael O'Connell, "MLOps: Operationalizing Data Science", O'Reilly Media, Inc., 1 st Edition , 2020, ISBN : 9781492074656

Course outcomes: On completion of the course, the student will have the ability to:

Course Code	CO#	Course Outcome(CO)
22AI742	CO1	Identify and apply various ML-Ops techniques to deploy machine learning models for real-world problems.
	CO2	Design, deploy and evaluate Machine Learning models, follow the operational practices to benefit society, science, and industry.
	CO3	Use modern tools and techniques to organize ML model from development to production for real world problems
	CO4	Demonstrate effective communication through team presentations and reports to analyse the impact of the standard MLOPs practices on industry and society.
	CO5	Conduct performance evaluation, design, deploy models in accordance with the appropriate Governance for the benefit of the industry and society

Augmented Reality and Virtual Reality		
Course Code	22AI743	CIE: 50
Credits	03	SEE: 50
Course Type	PEC -III	
Number of Lecture Hours/Week (L-T-P)	3-0-0	Total Marks:100
Total Number of Lecture Hours	42 Hours (Theory)	SEE Hours: 03

Course Objectives:

- To enable the students to obtain the knowledge of Virtual Augmented Reality in the following topics.
- To understand opportunities and the main issues related to designing and developing VR/AR systems architectures, both in local and in distributed (even web-based) contexts.
- To understand development of VR/AR applications with a multimodal perspective and approach

Modules	Teaching Hours
Module-I Introduction: The three I's of virtual reality, commercial VR technology and the five classic components of a VR system. Input Devices: (Trackers, Navigation, and Gesture Interfaces): Three dimensional position trackers, navigation and manipulation, interfaces and gesture interfaces.	10
Module-II Output Devices: Graphics displays, sound displays & haptic feedback.	08
Module-III Modeling: Geometric modeling, kinematics modeling, physical modeling, behavior modeling, model management.	08
Module-IV Human Factors: Methodology and terminology, user performance studies, VR health and safety issues.	08
Module-V Applications: Medical applications, military applications, robotics applications.	08

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 20 marks.
- Each full question will have sub questions covering all the topics under a module. The students will have to answer 5 full questions, selecting

one full question from each module.

Text Books:

" Virtual Reality Technology", Second edition, Grigore C. Burdea, Philippe Coiffet, A John Wiley & Sons, Inc., Publication

Reference Books:

1. Augmented Reality: A Practical Guide by Stephen Cawood and Mark Fiala.
2.Augmented Reality Principles and Practices by Dieter Schmalstieg and Tobias Hollerer.

Course outcomes: On completion of the course, the student will have the ability to:

Course Code	CO#	Course Outcome(CO)
22AI743	CO1	Describe the components of the virtual reality system.
	CO2	Describe various input and output devices used for virtual reality.
	CO3	Apply the different modeling concepts to visual virtualization.
	CO4	Analyze the performance of given simple applications related to virtual reality.
	CO5	Design 3D technology with virtual programming concepts in different applications.

Deep Learning and Reinforcement Learning		
Course Code	22AI744	CIE: 50
Credits	03	SEE: 50
Course Type	PEC -III	
Number of Lecture Hours/Week (L-T-P)	3-0-0	Total Marks:100
Total Number of Lecture Hours	42 Hours (Theory)	SEE Hours: 03

Course Objectives:

- Understand the fundamentals of deep learning and know the theory behind Convolutional Neural Networks, RNN.
- Illustrate the strength and weaknesses of many popular deep learning approaches.
- Introduce major deep learning algorithms, the problem settings, and their applications to solve real world problems

Modules	Teaching Hours
Module-I Introduction to Deep Learning Introduction, Shallow Learning, Deep Learning, Why to use Deep Learning, How Deep Learning Works, Deep Learning Challenges,. How Learning Differs from Pure Optimization, Challenges in Neural Network Optimization.	10
Module-II Basics of Supervised Deep Learning Introduction, Convolution Neural Network, Evolution of Convolution Neural Network, Architecture of CNN, Convolution Operation	08
Module-III Training Supervised Deep Learning Networks Training Convolution Neural Networks, Gradient Descent-Based Optimization Techniques, Challenges in Training Deep Networks. Supervised Deep Learning Architectures: LetNet-5,AlexNet	08
Module-IV Recurrent and Recursive Neural Networks Unfolding Computational Graphs, Recurrent Neural Network, Bidirectional RNNs, Deep Recurrent Networks, Recursive Neural Networks, The Long Short-Term Memory, Gated RNNs.	08
Module-V Deep Reinforcement Learning: Introduction, Stateless Algorithms: Multi-Armed Bandits, The Basic Framework of Reinforcement Learning, case studies.	08

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 20 marks.
- Each full question will have sub questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. M. Arif Wani Farooq Ahmad Bhat Saduf Afzal Asif Iqbal Khan, Advances in Deep Learning, Springer, 2020
2. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016.
3. Charu C. Aggarwal, "Neural Networks and Deep Learning", Springer, 2018.

Reference Books:

1. Bengio, Yoshua. "Learning deep architectures for AI." Foundations and trends in Machine Learning, 2009
2. N.D. Lewis, "Deep Learning Made Easy with R: A Gentle Introduction for Data Science", January 2016
3. Nikhil Buduma, "Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms", O'Reilly publications

Course outcomes: On completion of the course, the student will have the ability to:

Course Code	CO#	Course Outcome(CO)
22AI744	CO1	Demonstrate the implementation of deep learning techniques.
	CO2	Examine various deep learning techniques for solving the real world problems.
	CO3	Design and implement research-oriented scenario using deep learning techniques in a team.
	CO4	Examine the limitations of standard RNNs and how LSTM and Gated RNN architectures address them.
	CO5	Demonstrate practical understanding by implementing simple RL algorithms and evaluating their performance.

Software Engineering and Project Management		
Course Code	22AIOE751	CIE: 50
Credits	03	SEE: 50
Course Type	OEC - II	
Number of Lecture Hours/Week (L-T-P)	3-0-0	Total Marks:100
Total Number of Lecture Hours	42 Hours (Theory)	SEE Hours: 03

Course Objectives:

- Outline software engineering principles and activities involved in building large software programs. Identify ethical and professional issues and explain why they are of concern to Software Engineers.
- Describe the process of requirement gathering, requirement classification, requirement specification and requirements validation.
- Recognize the importance of Project Management with its methods and methodologies.
- Identify software quality parameters and quantify software using measurements and metrics. List software quality standards and outline the practices involved.

Modules	Teaching Hours
Module-I Software and Software Engineering: The nature of Software, The unique nature of WebApps, Software Engineering, The software Process, Software Engineering Practice, Software Myths. Process Models: A generic process model, Process assessment and improvement, Prescriptive process models: Waterfall model, Incremental process models, Evolutionary process models, Concurrent models, Specialized process models. Unified Process , Personal and Team process models	10
Module-II Understanding Requirements: Requirements Engineering, Establishing the ground work, Eliciting Requirements, Developing use cases, Building the requirements model, Negotiating Requirements, Validating Requirements. Requirements Modeling Scenarios, Information and Analysis classes: Requirement Analysis, Scenario based modeling, UML models that supplement the Use Case, Data modeling Concepts, Class-Based Modeling. Requirement Modeling Strategies : Flow oriented Modeling , Behavioral Modeling.	08
Module-III Agile Development: What is Agility?, Agility and the cost of change. What is an agile Process?, Extreme Programming (XP), Other Agile Process Models, A tool set for Agile process . Principles that guide practice: Software Engineering Knowledge, Core principles, Principles that guide each framework activity.	08

Module-IV Introduction to Project Management: Introduction, Project and Importance of Project Management, Contract Management, Activities Covered by Software Project Management, Plans, Methods and Methodologies, Some ways of categorizing Software Projects, Stakeholders, Setting Objectives, Business Case, Project Success and Failure, Management and Management Control, Project Management life cycle, Traditional versus Modern Project Management Practices. Project Evaluation: Evaluation of Individual projects, Cost–benefit Evaluation Techniques, Risk Evaluation	08
Module-V Software Quality: Introduction, The place of software quality in project planning, Importance of software quality, Defining software quality, Software quality models, product versus process quality management. Software Project Estimation: Observations on Estimation, Decomposition Techniques, Empirical Estimation Models.	08

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 20 marks.
- Each full question will have sub questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Roger S. Pressman: Software Engineering-A Practitioners approach, 7th Edition, Tata McGraw Hill.
2. Bob Hughes, Mike Cotterell, Rajib Mall: Software Project Management, 6th Edition, McGraw Hill Education, 2018.

Reference Books:

1. Pankaj Jalote: An Integrated Approach to Software Engineering, Wiley India.
2. “Software Engineering: Principles and Practice", Hans van Vliet, Wiley India, 3rd Edition, 2010

Course outcomes: On completion of the course, the student will have the ability to:

Course Code	CO#	Course Outcome(CO)
22AIOE751	CO1	Differentiate process models to judge which process model has to be adopted for the given scenarios.
	CO2	Derive both functional and nonfunctional requirements from the case study
	CO3	Analyze the importance of various software testing methods and agile methodology
	CO4	Illustrate the role of project planning and quality management in software development.
	CO5	Identify appropriate techniques to enhance software quality.

Major Project Phase - II		
Course Code	22AIP76	CIE: 50
Credits	06	SEE: 50
Course Type	PROJ	
Number of Lecture Hours/Week (L-T-P)	0-0-12	Total Marks:100
Total Number of Lecture Hours	24 Hours (Practical)	SEE Hours: 03

Course Objectives:

- Gain and revise the knowledge of contemporary issues through literature surveys.
- Design and implement the solution for real world problems.
- To apply programming skills for module implementation.
- Apply modern technologies and engineering tools.
- To enhance the project management skills.
- Work individually and as a team member in multidisciplinary domains with ethical standards.

Course outcomes: On completion of the course, the student will have the ability to:

Course Code	CO#	Course Outcome(CO)
22AIP76	CO1	Apply the basic engineering knowledge and identify the real world problem.
	CO2	Apply the engineering skills to solve problems which require engineering applications.
	CO3	Gain insights and evaluate the knowledge through literature survey and formulate the problems.
	CO4	Design and develop effective solution to the problem using software methodology.
	CO5	Prepare a well organized report and presentation.

Internship (Industry / Research)		
Course Code	22AIINT83	CIE: 100
Credits	10	SEE: 00
Course Type	INT	
Number of Lecture Hours/Week (L-T-P)	0-0-12	Total Marks:100

Course Objectives:

- Facilitate opportunities to enhance and apply advanced technical and managerial skills in real-time scenarios, preparing students to become industry-ready professionals.
- Expose students to cutting-edge technological developments in Artificial Intelligence, Machine Learning, Data Science, and related fields to ensure relevance in a rapidly evolving domain.
- Encourage the application of knowledge and experience gained during industrial internships or projects in classroom discussions to deepen conceptual understanding and critical thinking.
- Foster a research-driven academic environment that promotes curiosity, innovation, and the practical application of knowledge to real-world problems.
- Provide platforms for students to implement their expertise in real industrial use-cases, including model deployment, data engineering, and automation workflows.
- Train students in the effective communication of technical content through structured documentation and reporting of AI/ML models, experiments, and project outcomes.
- Introduce students to the ethical responsibilities of practitioners, emphasizing fairness, transparency, data privacy, and the societal impact of intelligent systems.
- Promote holistic development by integrating academic knowledge with career-focused learning and personal growth opportunities through mentorship, workshops, and capstone projects.

Guidelines:

- The duration of the Internship shall be of 14-20 weeks.
- Internship must be completed in the VII/VIII semester.
- Students undergoing internship training are advised to report their progress and submit periodic progress reports to their respective guides
- The student must prepare and submit the hard copy of the final internship report along the internship certification provided by the industry.