Shirpur Education Society's

R. C. Patel Institute of Technology, Shirpur

(An Autonomous Institute)

Course Structure and Syllabus

Final Year B. Tech

Artificial Intelligence and Machine Learning

With effect from Year 2024-25

Shahada Road, Near Nimzari Naka, Shirpur, Maharashtra 425405
Ph: 02563 259 802, Web: www.rcpit.ac.in

Final Year B. Tech Artificial Intelligence and Machine Learning Semester-VII (w.e.f. 2024-25)														
Sr	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme					Total	Credit	
							Continuous Assessment (CA)							
							TA	Term Test 1 (TT1)	Term Test 2 (TT2)	Average of (TT1 & TT2)	ESE			
				L	T	P	[A]			[B]	[C]	[A+B+C]		
1	PC	PCAI7010T	High Performance Computing	3			25	10	10	10	65	100	3	4
	PC	PCAI7010L	High Performance Computing Laboratory			2	25				25	50	1	
2	PC	PCAI7020T	Large Language Models	3			25	10	10	10	65	100	3	4
	PC	PCAI7020L	Large Language Models Laboratory			2	25				25	50	1	
3	PC	PCAI7030L	Big Data Laboratory			4	25				25	50	2	2
4@	PE	PEAI7041T	Robotics	3			25	10	10	10	65	100	3	4
		PEAI7041L	Robotics Laboratory			2	25				25	50	1	
		PEAI7042T	Artificial Intelligence in Finance	3			25	10	10	10	65	100	3	
		PEAI7042L	Artificial Intelligence in Finance Laboratory			2	25				25	50	1	
		PEAI7043T	Artificial Intelligence in Cyber Security	3			25	10	10	10	65	100	3	
		PEAI7043L	Artificial Intelligence in Cyber Security Laboratory			2	25				25	50	1	
5#	OE	OEAI7051T	Product Life Cycle Management	3			25	10	10	10	65	100	3	3
		OEAI7052T	Management Information System	3			25	10	10	10	65	100	3	
		OEAI7053T	Operations Research	3			25	10	10	10	65	100	3	
		OEAI7054T	Cyber Security and Laws	3			25	10	10	10	65	100	3	
		OEAI7055T	Personal Finance Management	3			25	10	10	10	65	100	3	
		OEAI7056T	Energy Audit and Management	3			25	10	10	10	65	100	3	
		OEAI7057T	Disaster Management and Mitigation Measures	3			25	10	10	10	65	100	3	
		OEAI7058T	Science of Well-being	3			25	10	10	10	65	100	3	
		OEAI7059T	Research Methodology	3			25	10	10	10	65	100	3	
		OEAI70510T	Public Systems and Policies	3			25	10	10	10	65	100	3	
6	PJ	PJAI7060L	Project Stage-II			8	25				25	50	4	4
			Total	12		18	225			40	385	650	21	

@Any 1 Professional Elective Course
#Any 1 Institute Professional Elective Course

Prepared by:
Ms. S. P. Salunkhe

Checked by:
Dr. P. S. Sanjekar

Prof. Dr. U. M. Patil
BOS Chairman

Prof. S. P. Shukla
C.O.E.

Prof. Dr. P. J. Deore
Dean Academics/Dy. Director

Prof. Dr. J. B. Patil
Director

Final Year B. Tech Artificial Intelligence and Machine Learning Semester-VIII (w.e.f. 2024-25)														
Sr	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme					Total	Credit	
							Continuous Assessment (CA)							
							TA	Term Test 1 (TT1)	Term Test 2 (TT2)	Average of (TT1 & TT2)	ESE			
				L	T	P	[A]			[B]	[C]	[A+B+C]		
1@	PE1	PEAI8011T	Reinforcement Learning*	3			25	10	10	10	65	100	3	3
		PEAI8012T	AI in Healthcare*	3			25	10	10	10	65	100	3	
		PEAI8013T	Quantum AI*	3			25	10	10	10	65	100	3	
		PEAI8014T	NPTEL/Swayam Course#	3			25	10	10	10	65	100	3	
2@	PE2	PEAI8021T	Ethical AI*	3			25	10	10	10	65	100	3	3
		PEAI8022T	Image Generative AI*	3			25	10	10	10	65	100	3	
		PEAI8023T	Social Network Analysis*	3			25	10	10	10	65	100	3	
		PEAI8024T	NPTEL/Swayam Course#	3			25	10	10	10	65	100	3	
3	INT	INTAI8030L	Internship			20	150				150	300	10	
			Total	6		20	200			20	280	500	16	

1. @ Any 1 Elective Course.
2. *Professional Elective Courses offered for the students doing Internship at institute level.
3. #Professional Elective Courses offered for the students doing Internship at Industry. These courses are to be studied in self study mode using NPTEL/Swayam platform.
4. Students doing internship at industry shall submit certificate of successfully passing respective NPTEL examination OR they have to appear examinations conducted by institute like TT1, TT2 and ESE.
5. List of NPTEL courses will be declared by concerned BOS at the beginning of semester-VIII.

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Director

Semester - VII

High Performance Computing (PCAI7010T)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 10 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisite: System Fundamentals

Course Objectives:

1. To learn concepts of parallel processing as it pertains to high-performance computing.
2. To design, develop and analyze parallel programs on high performance computing resources using parallel programming paradigm.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand different parallel processing approaches and platforms involved in achieving High Performance Computing.	L2	Understand
CO2	Explore GPU and CUDA Programming.	L2	Understand
CO3	Understand the principles of Grid and Cloud Computing with practical examples and applications.	L2	Understand
CO4	Analyze the performance measures in high performance computing.	L4	Analyze
CO5	Discover the advanced topic in GPU including libraries and framework.	L2	Understand

Course Contents

Unit-I — 04 Hrs.

Introduction to Parallel Processing:

Parallel processing, Levels of Parallelism, Models (SIMD, MIMD, SIMT, SPMD, Data Flow Models, Demand-driven Computation). Loosely coupled and Tightly coupled. Parallel Architecture (Interconnection network, processor Array, Multiprocessor), Challenges in Parallel Computing, Performance Metrics, Distributed vs. Parallel architectures.

Unit-II — 06 Hrs.

Introduction to High Performance Computing:

Principles of HPC, HPC Architectures, HPC vs Parallel Processing, Data partitioning Techniques: Block, cyclic, and block-cyclic partitioning, Domain Decomposition: Spatial, temporal, and functiona decomposition, Load balancing, Case Study: Partitioning strategies for matrix multiplication. Communication Models: Shared memory vs. message passing. Point-to-Point Communication: Send/Receive operations in MPI. Collective Communication: Broadcast, scatter, gather, and reduction operations in MPI (MPI_Reduce)

Unit-III — 08 Hrs.

GPU and CUDA Programming:

Overview of GPU, evolution of GPU, CPU vs. GPU, overview of CUDA: Features, Benefits, Architecture. Programming Model CUDA: Kernels and kernel launches, Thread and block indexing, CUDA Memory Management: Memory Hierarchy and Memory Management, Case Studies: computational biology, data analytics, and machine learning.

Unit-IV — 07 Hrs.

Grid and Cloud Computing:

Data & Computational Grids, Grid Architectures and its relation to various Distributed Technologies, Examples of The Grid Computing, Cloud Computing, High Performance Cloud Computing (HPC2), Cloud Tensor Processing Units (TPUs).

Unit-V — 08 Hrs.

Performance Optimization:

Speedup, Efficiency and Scalability, Amdahl's Law, Gustafson's Law, Weak vs. Strong Scaling, Performance Bottlenecks, Data Races and Determinism, Data Race Avoidance, Profiling and performance analysis tools for GPUs, Techniques for optimizing GPU performance (warp divergence, loop unrolling, vectorization), Memory bandwidth optimization techniques, Advanced GPU programming.

concepts (shared memory atomics, warp shuffling).

Case Studies: Scientific Computing with CUDA/Real-life application

Unit-VI 06 Hrs.

Advanced Topics in GPU:

Introduction to GPU accelerated libraries (cuBLAS, cuDNN, cuGraph), GPU computing frameworks (TensorFlow, PyTorch) and their integration with GPUs, Introduction to GPU clusters and distributed GPU computing, Cluster Setup & its Advantages. Case studies : Real- world applications of GPU computing.

Text Books:

1. Edson Borin, Lúcia Maria A. Drummond , Jean-Luc Gaudiot, Alba Melo, Maicon Melo Alves, "High Performance Computing in Clouds: Moving HPC Applications to a Scalable and Cost-Effective Environment", Philippe Olivier Alexandre Navaux, Springer, ISBN-13 978- 3031297687, 2023.

2. Alexander Heifetz, "High Performance Computing for Drug Discovery and Biomedicine", Springer Nature, ISBN, 1071634496, 9781071634493, 2023.

3. Richard Ansorge, "Programming in Parallel with CUDA", Cambridge University Press, ISBN-13 978-1108479530, 2022.

4. Robert Robey, Yuliana Zamora, "Parallel and High Performance Computing", Manning publisher, ISBN-13 978-1617296468, 2021.

5. Sergey A. Babkin,"The Practice of Parallel Programming", CreateSpace Publisher ISBN-13: 978-1451536614, Online Edition 2021.

6. Georg Hager, Gerhard Wellein, "Introduction to High Performance computing for Scientist and Engineers", CRC press, 2019.

7. Dr Brian Tuomanen, "Hands-On GPU Programming with Python and CUDA" , Packt Publishing, ISBN-13 978-1788993913, 2018.

Reference Books:

1. David B. Kirk and Wen-mei W. Hwu, Morgan Kaufmann, "Programming Massively Parallel Processors: A Handson Approach", 4th Edition, 2022.

2. Jason Sanders and Edward Kandrot, "CUDA by Example: An Introduction to General-Purpose GPU Programming", Addison-Wesley, 1st Edition, 2010.

3. Hager, G. and Wellein, G, "Introduction to High Performance Computing for Scientists and Engineers", CRC Press, ISBN-13 9781439811931, 2010.

4. "High Performance Computing For Dummies", Sun and AMD Special Edition, Douglas Eadline Wiley Publishing, Inc. (2009)

Web Links:

1. Parallel Processing https://hpc.llnl.gov/documentation/tutorials/introduction-parallel- computing-tutorial
2. Introduction to high performance computing https://www.cecam.org/workshop-details/an- introduction-to-high-performance-computing-1270
3. GPU and CUDA Programming https://www.cs.cmu.edu/afs/cs/academic/class/15418-s18/www/lectures/06_gpuarch.pdf
4. Grid and Cloud Computing https://aitc-tpt.edu.in/wp-content/uploads/2022/06/GCC-min.pdf
5. Performance Optimization https://link.springer.com/chapter/10.1007/978-3-642-03644- 6_12
6. Case Study: https://developer.nvidia.com/blog/a-cuda-dynamic-parallelism-case-study-panda/
7. Case Study https://www.researchgate.net/publication/265817932_CUDA-based_scientific_computing_Tools_and_selected_applications

Evaluation Scheme:

Theory :

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 10 marks each will be conducted during the semester.
2. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

High Performance Computing Laboratory (PCAI7010L)

Practical Scheme
Practical : 02 Hrs./week
Credit : 01

Examination Scheme
Teacher Assessment : 25 Marks
End Sem Exam : 25 Marks
Total : 50 Marks

Course Objectives:

1. Gain a comprehensive understanding of various high performance computing architectures, including multicore processors, GPUs, and distributed computing systems.
2. Learn to develop, optimize, and debug parallel programs using HPC tools and frameworks such as MPI, OpenMP, and CUDA.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Demonstrate a thorough understanding of various HPC architectures, including their design, functionality, and application in solving computational problems.	L2	Understand
CO2	Develop, optimize, and debug parallel programs using tools and frameworks such as MPI, OpenMP, and CUDA, effectively leveraging parallelism to enhance computational performance.	L3	Apply
CO3	Apply HPC techniques to solve complex computational problems in various domains such as scientific computing, data analysis, and machine learning, demonstrating the practical application of theoretical knowledge.	L3	Apply
CO4	Gain substantial hands-on experience through lab exercises, projects, and case studies that simulate real-world HPC applications, preparing them for real-world challenges.	L5	Evaluate

List of Laboratory Experiments

Suggested List of Experiments:

1. Set up the CUDA environment, install the CUDA Toolkit, and write a basic CUDA program to understand the CUDA development environment.
2. Implement vector addition using CUDA to introduce students to parallelism, thread management, and memory allocation in GPU programming.
3. Develop a CUDA program for matrix multiplication to understand parallelism and optimization techniques in GPU computing.
4. Apply CUDA for image processing tasks, like blurring and edge detection, to learn how to process images efficiently using GPU parallelism.
5. Implement parallel reduction operations (e.g., sum, min, max) to grasp the concept of efficient parallel reduction.
6. Explore parallel sorting algorithms using CUDA, comparing their performance with CPU based sorting and optimizing CUDA sorting.
7. Employ CUDA to perform a Monte Carlo simulation for estimating mathematical constants or solving real-world problems to understand the power of GPU parallelism.
8. Experiment with CUDA to implement concurrent data structures using locks and atomic operations to learn how to manage data concurrently.
9. Optimize the reduction step in machine learning algorithms using CUDA, focusing on techniques for efficient large-scale data processing.
10. Integrate CUDA-accelerated code with data science frameworks like TensorFlow or PyTorch to develop and run GPU-accelerated machine learning models for practical applications.
11. Perform the Log Analysis-Based Resource and Execution Time Improvement.

Any other experiment based on syllabus may be included, which would help the learner to understand topic/concept.

Evaluation Scheme:

Laboratory:

Continuous Assessment (A):

Laboratory work will be based on PCAI7010T with minimum 08 experiments to be incorporated.

The distribution of marks for term work shall be as follows:

1. Performance in Experiments: 05 Marks
2. Journal Submission: 05 Marks
3. Viva-voce: 05 Marks
4. Subject Specific Lab Assignment/Case Study: 10 Marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

End Semester Examination (C):

Oral/ Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Large Language Models (PCAI7020T)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 10 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisite: Natural Language Processing, Deep Learning.

Course Objectives:

1. Introduce the fundamental concepts and applications of Generative AI.
2. Provide in-depth understanding of Transformer architecture, the core building block of most Large Language Models (LLMs).
3. Explore various LLM architectures and techniques like BERT, prompt engineering, and fine-tuning.
4. Equip students with the ability to evaluate LLM performance and identify potential biases.
5. Introduce students to Multimodal LLMs that can process and understand different data modalities.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Introduce the fundamental concepts and applications of Generative AI and to provide in-depth understanding of Transformer architecture, the core building block of Large Language Models (LLMs).	L2	Understand
CO2	Explore various LLM architectures and techniques like BERT, GPT-3, T5.	L2	Understand
CO3	Apply prompt engineering techniques for effective LLM interaction and understand the concept of Retrieval Augmented Generation (RAG) and its role in LLMs.	L3	Apply
CO4	Evaluate LLM performance and identify potential biases and understand multimodal LLMs that can process and understand different data modalities.	L5	Evaluate

Course Contents

Unit-I — 08 Hrs.

Module 1: Introduction to Generative AI &Transformer Architecture - The Engine of LLMs

Domains of Generative AI, Text Generation, Image Generation, Music Generation, Video Generation. Limitations of RNN & LSTM, Understanding the core building block of most LLMs - the Transformer model, Tokenization, Decoding the Transformer's components: encoders, decoders, attention mechanisms - types, Self-attention vs Flash Attention, feed-forward layer, Reinforcement Learning with AI Feedback (RLAIF), Reinforcement Learning from Human Feedback (RLHF)

Unit-II — 08 Hrs.

Module 2: Language Models - Unveiling the Power of Words

Diving into different LLM architectures: BERT (Bidirectional Encoder Representations from Transformers) and its applications, exploring other notable LLM architectures (e.g.GPT-3, T5), Mixture of Experts (MoE), various benchmarks to evaluate LLMs

Unit-III — 07 Hrs.

Module 3: Prompt Engineering

Introduction to prompt, examples of prompt, prompt engineering, prompt techniques, zero shot, one shot, few-shot learning, a chain of thought prompting, ReAct Prompting, self-consistency, Tree of thought, LLM based Agents, Large Action Models(LAMs).

Unit-IV — 06 Hrs.

Module 4: Retrieval Augmentation & Generation (RAG) and Fine-tuning for LLMs

Understanding Retrieval and vector, vector storage: vector indexing, vector libraries, vector databases, Loading and retrieving in Lang Chain Document loaders, Retrievers in Lang Chain. Fine-tuning: Quantization PEFT, Full-Fine-tuning vs LoRA vs QLoRA, Fine-Tuning LLMs for different downstream tasks.

Unit-V — 06 Hrs.

Module 5: Evaluating LLMs - Measuring Performance and Biases

Learning about common metrics for evaluating LLM performance (e.g., perplexity, BLEU score). Understanding the challenges of bias and fairness in LLMs. Exploring techniques for mitigating bias in LLM development and evaluation, considering prompt design and data selection for RAG RAGAS

Unit-VI

04 Hrs.

Module 6: Multimodal Architectures - Beyond Text

Introduction to Multimodal LLMs: processing and understanding different data types (text, images, audio). Exploring architectures for Multimodal LLMs: separate encoders, joint embedding spaces. Applications of Multimodal LLMs (e.g., image captioning, video summarization), Multi- task LLMs, Empowering Time Series Analysis with Large Language Models

Text Books:

1. Ben Auffarth, "Generative AI with LangChain: Build large language model (LLM) apps with Python, ChatGPT, and other LLMs" by Packt Publishing, 2023.
2. Valentina Alto, "Modern Generative AI with ChatGPT and OpenAI Models", by Packt Publishing, 2023.
3. Jay Alammar, Maarten Grootendorst, "Hands-On Large Language Models", by O'Reilly, 2023
4. Thushan Ganegedara, "Natural Language Processing with TensorFlow", by Packt Publishing, 2nd Edition, 2022.

Reference Books:

1. David Foster, "Generative Deep Learning", O'Reilly, 2020.
2. Lewis Tunstall, Leandro von Werra & Thomas Wolf, "Natural Language Processing with Transformers", 2022.
3. Sebastian Raschka, "Build a Large Language Model (From Scratch)", ISBN 9781633437166

Web Links:

1. Mixture of Experts: Mixture of Experts Explained (huggingface.co)
2. PEFT:Efficient Model Fine-Tuning for LLMs: Understanding PEFT by Implementation — by Shivansh Kaushik — Medium
3. Various benchmarks to evaluate LLMs: LLM Benchmarks: Understanding Language Model Performance (humanloop.com)
4. Types of attention mechanism: Understanding and Coding the Self-Attention Mechanism of Large Language Models From Scratch (sebastianraschka.com)
5. Agents— RAG: Intro to LLM Agents with Langchain: When RAG is Not Enough — by Alex Honchar — Mar, 2024 — Towards Data Science
6. React— Agent: Teaching LLMs to Think and Act: ReAct Prompt Engineering — by [illegible] McKenney — Medium

7. LLM based Agents : Superpower LLMs with Conversational Agents — Pinecone
8. RAGAS: Evaluating RAG pipelines with Ragas + LangSmith (langchain.dev)
9. Model distillation: LLM distillation demystified: a complete guide — Snorkel AI
10. Sentence classifier —BERT: Classify text with BERT — Text — TensorFlow

Evaluation Scheme:

Theory :

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 10 marks each will be conducted during the semester.
2. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Large Language Models Laboratory (PCAI7020L)

Practical Scheme
Practical : 02 Hrs./week
Credit : 01

Examination Scheme
Teacher Assessment : 25 Marks
End Sem Exam : 25 Marks
Total : 50 Marks

Course Objectives:

1. Implement various LLM Application using language Chain and Fine Tune LLAMA 2.
2. Understand and implement Text Classification Using BERT and Tensorflow.
3. Understand and design Multimodal Generative Model.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Build your own simple LLM Application using Lang Chain, Query PDF using Lang Chain and Pine cone.	L6	Create
CO2	Implement Fine Tune LLAMA 2 With Custom Dataset Using LoRA And QLoRA Techniques. Text classification using BERT and Tensorflow.	L3	Apply
CO3	Design Question Answering Application using LLM based agents. Apply in-built tools and creating custom tools for ReAct agent in Langchain. Monitoring RAG applications using Langsmith and evaluating using ragas.	L6	Create
CO4	Build a simple multimodal generative model that combines text and image inputs to generate captions.	L6	Create
CO5	Understanding multimodal models like Gemini vision, various retrievers in Langchain. Apply Open-sourced LLMs for function calling.	L2,L3	Understand, Apply

List of Laboratory Experiments

Suggested List of Experiments:

1. Build your own simple LLM Application using Lang Chain.
2. Query PDF using Lang Chain and Pine cone.
3. Fine Tuning Pre-trained Model On Custom Dataset Using Transformer.
4. Fine Tune LLAMA 2 With Custom Dataset Using LoRA And QLoRA Techniques.
5. Text classification using BERT and Tensorflow.
6. Question Answering Application using LLM based agents.
7. Using in-built tools and creating custom tools for ReAct agent in Langchain.
8. Monitoring RAG applications using Langsmith and evaluating using ragas.
9. Build a simple multimodal generative model that combines text and image inputs to generate captions.
10. Understanding multimodal models like Gemini vision.
11. Understanding various retrievers in Langchain.
12. Open-sourced LLMs for function calling.
13. Mini project

Any other experiment based on syllabus may be included, which would help the learner to understand topic/concept.

Evaluation Scheme:

Laboratory:

Continuous Assessment (A):

Laboratory work will be based on PCAI7020T with minimum 08 experiments to be incorporated. The distribution of marks for term work shall be as follows:

1. Performance in Experiments: 05 Marks
2. Journal Submission: 05 Marks
3. Viva-voce: 05 Marks
4. Subject Specific Lab Assignment/Case Study: 10 Marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

End Semester Examination (C):

Oral/ Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Big Data Laboratory (PCAI7030L)

Teaching Scheme
Practical : 04 Hrs./week
Credits : 02

Examination Scheme
Teacher Assessment: 25 Marks
End Sem Exam : 25 Marks
Total Marks : 50 Marks

Prerequisite: Database Management System, Basic Programming skills.

Course Objectives:

1. Master the setup and configuration of Hadoop clusters using Cloudera, establishing a Hadoop Distributed File System (HDFS).
2. Develop practical skills in MapReduce programming, including Word Count and other examples.
3. Gain proficiency in PostgreSQL installation, database creation, and CRUD operations.
4. Gain proficiency in Pig and Hive built-in functions, master the data transformation with RRD.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Set up and configure Hadoop clusters, and Implement MapReduce programs for data processing and analysis.	L3	Apply
CO2	Utilize PostgreSQL/MongoDB for database management, including creating and managing schemas, tables, and performing complex queries with conditions and joins.	L4,L5	Analyze, Evaluate
CO3	Implement Hive built-in functions and operators, execute data processing scripts using Pig Latin.	L3	Apply
CO4	Work with Spark to create and manage RDDs, perform actions and transformations, and implement Machine Learning Algorithms.	L6	Create

Course Contents

Unit-I — 08 Hrs.

Set up and Configuration Hadoop Using Cloudera Creating a HDFS System with minimum 1 Name Node and 1 Data Nodes HDFS Commands, Set up Hadoop in Linux Environment

Unit-II — 08 Hrs.

Map Reduce Programming Examples Word Count. Union, Intersection and Difference. Matrix Multiplication. Natural Join Programming Example

Unit-III — 10 Hrs.

PostgreSQL Database: Data Types, PostgreSQL Schema, Queries, PostgreSQL Table Queries , Clause, PostgreSQL Conditions, Joins and View.

Mongo DB: Installation and Creation of database and Collection CRUD Document: Insert, Query, Update and Delete Document

Unit-IV — 08 Hrs.

Hive: Introduction Creation of Database and Table, Hive Partition, Hive Built in Function and Operators, Hive View and Index. Configure Hive Metastore to MySQL

Unit-V — 08 Hrs.

Pig: Pig Latin Basic Pig Shell, Pig Data Types, Creating a Pig Data Model, Reading and Storing Data, Pig Operations.

Unit-VI — 10 Hrs.

Spark: RDD, Actions and Transformation on RDD , Ways to Create - file, data in memory, other RDD. Lazy Execution, Persisti RDD Machine Learning Algorithms like K-Means using Spark. Visualization: Connect to data, Build Charts and Analyze Data, Create Dashboard, Create Stories using Tableau.

Suggested List of Laboratory Experiments

1. Install, configure and run Hadoop and HDFS.
2. Implement word count / frequency programs using MapReduce.
3. Implementing simple algorithms in MapReduce Matrix multiplication, Aggregates, joins, sorting.
4. Implement Page Rank Algorithm using Map-Reduce.
5. Install and setup PostgreSQL and run basic table commands.
6. Implement advance commands in PostgreSQL.
7. Create Hive Databases and Tables, Hive Partitioning and Indexing.
8. Use built-in Hive functions and operators to manipulate and query data. Perform aggregations, filtering, and data transformations using HiveQL.
9. Implement and Perform Streaming Data Analysis using flume for data capture, HIVE for data analysis of twitter data, chat data, weblog analysis.
10. Write Pig scripts to solve specific data processing tasks or analyze sample datasets.
11. Create RDDs from various data sources such as files and in-memory collections. Perform transformations and actions on RDDs and analyze the results.
12. Implement k-means clustering technique using SPARK.
13. Data Visualization with Tableau.

A minimum of 08 experiments or any other experiment based on syllabus will be included, which would help the learner to apply the concept learnt.

Text Books:

1. Peter Bruce, Andrew Bruce, Peter Gedeck, "Practical Statistics for Data Scientists", 2nd Edition, O Reilly Publisher, 2020.
2. Howard J. Seltman, "Experimental Design and Analysis", July 11, 2018.
3. Tom Mittchell , "Machine Learning", McGraw Hill,2017.

Reference Books:

1. "Data Mining for Business Analytics, (An Indian Adaptation): Concepts, Techniques and Applications in Python", Cambridge University Press, ISBN NO. 978-1108727747, 2019.

2. Andreas C. Müller and Sarah Guido, "Introduction to Machine Learning with Python: A Guide for Data Scientists", O'reilly,2016

3. Stephen Marsland, "Machine Learning an Algorithmic Perspective", CRC Press, 2015

4. Han Kamber, "Data Mining Concepts & Techniques", Morgan Kaufmann Publishers, 2012.

5. Kevin P. Murphy, "Machine Learning- A Probabilistic Perspective", 2012.

Web Links:

1. https://hadoop.apache.org/docs/stable/hadoop-project-dist/hadoop- common/SingleCluster.html
2. https://www.datacamp.com/tutorial/tableau-tutorial-for-beginners
3. https://hadoop.apache.org/docs/stable/hadoop-mapreduce-client /hadoop-mapreduce-client-core/MapReduceTutorial.html
4. https://hadoop.apache.org/docs/r1.2.1/mapred_tutorial.html#Example:+Matrix+Multi plication
5. https://www.postgresqltutorial.com/
6. https://www.postgresql.org/docs/current/queries.html
7. https://cwiki.apache.org/confluence/display/Hive/LanguageManual
8. https://cwiki.apache.org/confluence/display/Hive/LanguageManual+DDL#Language ManualDDL-PartitionedTables
9. https://cwiki.apache.org/confluence/display/Hive/LanguageManual+UDF
10. https://pig.apache.org/docs/r0.17.0/start.html
11. https://pig.apache.org/docs/r0.17.0/basic.html
12. https://spark.apache.org/docs/3.5.1/

Online Course:

1. https://onlinecourses.nptel.ac.in/noc20_cs92/preview

Evaluation Scheme:

Laboratory:

Continuous Assessment (A): 25 Marks:

Laboratory work will be based on PCAI7030L with minimum 08 experiments to be incorporated. The distribution of marks for term work shall be as follows:

1. Performance in Experiments: 05 Marks

2. Journal Submission: 05 Marks

3. Viva-voce: 05 Marks

4. Subject Specific Lab Assignment/Case Study: 10 Marks .

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

End Semester Examination (C): 25 Marks:

Oral / Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Robotics (PEAI7041T)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 10 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Course Objectives:

1. Develop a comprehensive understanding of robot anatomy.
2. Gain proficiency in direct and inverse kinematics, coordinate frames, and rotations.
3. Learn the principles of workspace analysis, trajectory planning, and various motion operations to design and implement efficient robotic movements.
4. Integrate and Program Robotic Systems.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain the basics of robot anatomy, movement mechanisms, and classifications, and apply this knowledge to real-world robotic systems.	L2	Understand
CO2	Perform kinematic analysis and solve direct and inverse kinematics problems for various robot configurations, enhancing their problem-solving skills in robotics.	L3	Apply
CO3	Conduct workspace analysis and trajectory planning, and will implement pick-and place.	L4	Analyze
CO4	Capable of using ROS for robot programming, interface sensors and actuators.	L3	Apply

Course Contents

Unit-I — 08 Hrs.

Robot Fundamentals: Basic of Robot Anatomy, Robot Movement, Mechanisms and transmission, Classification.

Direct and Inverse Kinematics: Co-ordinate frames, Rotations, Link Coordination Arm Equation, (Two axis , Three axis, Four-axis robot SCARA, Five-axis only Rhino XR-3 Robot).General properties of solutions Tool configuration Two axis, Three axis planar articulated, Four axis SCARA, Five axis robots only Rhino XR-3 Robot

Unit-II — 06 Hrs.

Workspace Analysis and Trajectory Planning: Introduction to Workspace Analysis and Trajectory Planning, Work Envelop and examples, Pick and place operations, Continuous path motion, Interpolated motion, Straight-line motion.

Unit-III — 08 Hrs.

Robot Sensor, Actuator, Interface & Programming: Principle of sensors, Sensor types: LiDAR (Light Detection and Ranging, Ultrasonic sensors, Camera. Sensor Input/output (I/O): Analog-to-Digital Converters (ADCs), Sensor Calibration, Interfacing and I2C, Actuator: Direct Control and Speed Control: PWM, Electric Motors, Pneumatic Actuator, Servo Motors. Basic Embedded File system, hex files, Simulators and Emulators, Integrated development environments, commonly used IDE. Python for Robot Programming, Program structure, data types, control structure.

Unit-IV — 08 Hrs.

Robotics Convergence Technology: Telemetric camera Robotic System, Non- Imaging Sensors Machine Learning for Robotics: Supervised learning for robot control, Reinforcement learning for robot decision making. Computer Vision for Robotics: Object recognition, Image segmentation, Visual SLAM (Simultaneous Localization and Mapping)

Sensor Fusion and Perception: Combining data from multiple sensors for robot understanding. Knowledge representation, planning, and task scheduling. Sound and touch sensing, People sensing, Autonomous mobile robot, humanoid robots and simulated humans, human-robot interaction.

Unit-V — 04 Hrs.

Robot Operating System ROS Basics, Supporting ROS, ROS Architecture and Concepts, ROS File system, ROS Computation Graph Level, ROS Community Level, ROS Workspace and Packages, ROS Client Library, ROS Programming Concept: Motion planning, Behavior control, Machine learning integration.

Unit-VI

05 Hrs.

Building the Robots: Introduction to Wheeled Robot, Hardware, Block Diagram and Assembling Robot Hardware, Programming Robot Firmware, path planning.

Robot Applications in AI (case studies): Exploration of self-driving cars, industrial robots, assistive robots, and other AI-powered robotic applications. Focus on the interplay between hardware and software aspects. Case study: Tetrix , NAO, Ned Niryo , Auto Auto.

Text Books:

1. Dr. M. Purushotham, T V Sathyanarayana, Dr. Shafqat Nabi Mughal, Dr. Pallavi Sapkale, "Basic concepts of AI and Robotics", AG Publishing House, ISBN: 9788119025343, 1st Edition, 2023.
2. Ishwar Singh, Birinder Pal Kaur, "Fundamentals of Robot Kinematics and Dynamics", ISBN-13 979-8870762753, 2023.
3. Lentin Joseph, "Robot Operating System (ROS) for Absolute Beginners: Robotics Programming Made Easy,", 1st Edition, A Press, 2018.
4. W. Bolton, "Mechatronics", Pearson, 2018.
5. Jonathan Cacace; Lentin Joseph, "Mastering ROS for Robotics Programming: Design, build, and simulate complex robots using the Robot Operating System", 2nd Edition, Packet Publishing, 2018.
6. Jacob Fraden, "Handbook of Modern Sensors", Springer 2016.

Reference Books:

1. Catherine Régis (Editor), Jean-Louis Denis (Editor), Maria Luciana Axente (Editor), Atsuo Kishimoto (Editor), "Human-Centered AI: A Multidisciplinary Perspective for Policy-Makers, Auditors, and Users", ISBN 13- 978-1032341620, 2024.
2. "Introduction To AI Robotics", 2nd Edition, Bradford Books, ISBN 13- 978- 0262038485, 2019.
3. Mikell P. Groover, "Industrial Robotics", 2nd Edition, McGraw Hill, 2012.
4. John J. Craig, "Introduction to Robotics", 3rd Edition, Addison Wesley, ISE 2008.

Online Resources:

1. Robot Anatomy, Movement, Mechanisms, and Transmission
   https://motion.cs.illinois.edu/RoboticSystems/AnatomyOfARobot.html
2. robot configurations and joint types
   https://instrumentationtools.com/robot-anatomy- configuration-reference-frame-characteristics/

3. Workspace Analysis and Trajectory Planning
   https://motion.cs.illinois.edu/RoboticSystems/AnatomyOfARobot.html

4. Robot Interface & Programming https://www.wevolver.com/article/robot-joint

5. Basic Embedded Systems and Python for Robot Programming
   https://motion.cs.illinois.edu/RoboticSystems/AnatomyOfARobot.html

6. Robotics Convergence Technology
   https://www.wevolver.com/article/robot-joint

7. Robot Operating System (ROS)
   https://instrumentationtools.com/robot-anatomy- configuration-reference-frame-characteristics/

8. Building Robots and Path Planning
   https://instrumentationtools.com/robot-anatomy-configuration-reference-frame-characteristics/

9. Robot Applications in AI (Case Studies) https://www.wevolver.com/article/robot-joint

Evaluation Scheme:

Theory :

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 10 marks each will be conducted during the semester.

2. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 65 marks.

2. Total duration allotted for writing the paper is 3 hrs.

Robotics Laboratory (PEAI7041L)

Practical Scheme
Practical : 02 Hrs./week
Credit : 01

Examination Scheme
Teacher Assessment : 25 Marks
End Sem Exam : 25 Marks
Total : 50 Marks

Course Objectives: Guide students in developing ROS-based applications, including creating and running publisher and subscriber nodes, and using ROS tools for simulation and visualization.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Identify and understand the various parts of a robot & Study different types of mechanisms and transmission systems in robot.	L2	Understand
CO2	Analyse the workspace of a four-axis SCARA robot and identify its limitations using simulation software.	L4	Analyze
CO3	Create and run basic publisher and subscriber nodes in ROS.	L3,L6	Apply,Create
CO4	Integrate ROS with Arduino or Raspberry Pi, showcasing the ability to implement and run ROS nodes, topics, and services on these platforms.	L3	Apply

List of Laboratory Experiments

Suggested List of Experiments:

1. Exploring Robot Anatomy

   Objective: Identify and understand the various parts of a robot (e.g., sensors, actuators, controllers).

   Objective: Study different types of mechanisms (e.g., gears, belts) and transmission systems in robots.

2. Simulation of Forward and Inverse Kinematics.

3. Workspace Analysis of a SCARA Robot

   Objective: Analyse the workspace of a four-axis SCARA robot and identify its limitations using simulation software.

4. Create a Robot structure for pick and place operation

5. Basic ROS Node Creation Objective: Create and run basic publisher and subscriber nodes in ROS.

   (Write simple nodes in Python/C++ and communicate between them.)

6. Implement a line following robot using ROS and appropriate sensors.

7. Interfacing Arduino/ Raspberry Pi with ROS.

8. Programs of Tetrix and NAO.

9. Programs on Ned Niryo and Auto Auto.

Any other experiment based on syllabus may be included, which would help the learner to understand topic/concept.

Evaluation Scheme:

Laboratory:

Continuous Assessment (A):

Laboratory work will be based on PEAI7041T with minimum 08 experiments to be incorporated. The distribution of marks for term work shall be as follows:

1. Performance in Experiments: 05 Marks
2. Journal Submission: 05 Marks
3. Viva-voce: 05 Marks
4. Subject Specific Lab Assignment/Case Study: 10 Marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

End Semester Examination (C):

Oral/ Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Artificial Intelligence in Finance (PEAI7042T)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 10 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Course Objectives:

The course objective is to understand the role of AI in finance, learn risk and portfolio management, develop and evaluate the credit scoring models, and investigate the application of AI in detection and prevention of fraud.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Demonstrate Knowledge of AI Applications and its role in Finance.	L3	Apply
CO2	Implement Risk Management Models to assess and manage financial risks.	L3	Apply
CO3	Optimize financial portfolio strategies that align with given risk profiles and investment goals.	L4	Analyze
CO4	Develop AI-driven credit scoring models and compare their performance to traditional scoring systems.	L6	Create
CO5	Design the fraud detection system that detect and prevent potential fraudulent activities.	L6	Create

Course Contents

Unit-I — 08 Hrs.

Introduction:

Taxonomy for finance- asset, liabilities, income, expenses, revenue, profit, cost of goods sold (COGS), gross margin, net income, balance sheet, income statement, ROI, liquidity, interest, inflation, financial markets (stock, Bond, commodity, forex), Equities, derivatives, Corporate and personal finance, Financial Statements and ratios, financial planning.

Unit-II — 08 Hrs.

Role of AI in Finance: AI and its significance in finance, evolution of AI in finance, AI techniques used in finance, Forecasting and its importance in finance, challenges in financial forecasting, Forecasting Methods: TSA, ML, DL, Semantics Analysis, Applications of AI in Finance: fraud detection, credit scoring, algorithmic trading, risk management.

Efficient Markets: Market Prediction Based on Returns Data, Market Prediction with More Features, Market Prediction Intraday.

Dense Neural Networks: The Data, Baseline Prediction, Normalization, Dropout, Regularization, Bagging, Optimizers.

Recurrent Neural Networks: Example - Financial Price Series, Financial Return Series, Financial Features, Estimation.

Unit-III — 06 Hrs.

Risk Management using AI and ML Models:

Introduction to financial risk management, Types of financial risk (market, credit, operational), AI and ML models for risk management (e.g., Value at Risk, Conditional Value at Risk), Case studies: Implementing risk management strategies using AI and ML.

Unit-IV — 05 Hrs.

Portfolio Optimization and Asset Allocation Strategies: Basics of portfolio theory, Portfolio optimization techniques (Markowitz, Black-Litterman, etc.), Application of AI and ML in portfolio optimization, Hands-on: Portfolio optimization using Python libraries.

Unit-V — 06 Hrs.

Credit Scoring in Finance:

Credit scoring and its importance in lending decisions, development of credit scoring models, regulation in credit scoring, Data Collection and Preprocessing for Credit Scoring, models for credit scoring-traditional machine learning and Deep learning, Evaluation and Validation of Credit Scoring.

Models-ROC, AUC, etc. Case studies of credit scoring model.

Unit-VI 06 Hrs.

Fraud Detection in Finance:

Fraud in finance and its impact, Types of financial fraud (e.g., identity theft, payment fraud), Importance of fraud detection in financial institutions, Data Collection and Preprocessing for Fraud Detection, traditional fraud detection methods (e.g., rule-based systems, anomaly detection) and its limitations, machine learning for fraud detection, anomaly detection techniques- supervised and unsupervised, Case studies of fraud detection model.

Text Books:

1. Edward P. K. Tsang, "AI for Finance", CRC Press, ISBN13 978-1032391205, 2023.
2. Bohdan Popovych, "Application of AI in Credit Scoring Modeling", Springer Gabler , ISBN- 13 978-3658401795, 2022.
3. illiam Kinlaw , Mark P. Kritzman, David Turkington, Harry M. Markowitz, "Asset Allocation: From Theory to Practice and Beyond (Wiley Finance)", ISBN-13 978-1119817710, 2021.
4. Marcos López de Prado, "Advances in Financial Machine Learning", Wiley, 2018.
5. Robert H. Shumway and David S. Stoffer, "Time Series Analysis and Its Applications: With R Examples" , 2017.
6. Yves Hilpisch, "Python for Finance: Analyze Big Financial Data", 2015.
7. Allan M. Malz, "Financial Risk Management: Models, History, and Institutions", 2011.
8. Frank J. Fabozzi, Harry M. Markowitz, and Petter N. Kolm, "Portfolio Construction and Analytics", , 2007.

Reference Books:

1. "AI In Banking & Finance: How AI Plays A Significant Role In Banking And Financial Services Industry: Artificial Intelligence Definition", Ila Sweda, ISBN-13 979-8465705233, 2021.
2. Matthew F. Dixon, Igor Halperin, and Paul Bilokon, "Machine Learning in Finance: From Theory to Practice" Springer, ISBN-13 978-3030410674 2020.
3. Marcos Lopez de Prado, "Machine Learning for Financial Engineering", Cambridge University Press, ISBN-13 978-1108792899, 2018.
4. Marcos Lopez de Prado, "Advances in Financial Machine Learning", Wiley, ISBN-13 978-1119482086, 2018.

5. Mark J. Bennett and Dirk L. Hugen, "Financial Analytics with R: Building a Laptop Laboratory for Data Science" , 2016.

Online Resources:

1. What Is Artificial Intelligence in Finance? — IBM
2. How Finance & Banking Professionals Can Capitalize on AI (corporatefinanceinstitute.com)
3. AI in Finance: Applications, Examples & Benefits — Google Cloud
4. 33 Examples of AI in Finance 2024 — Built In
5. AI for portfolio management: An overview (leewayhertz.com)
6. Generative AI transforming wealth and asset management — EY - US
7. Use of Artificial Intelligence (AI) in Investment Management — Infosys BPM
8. AI-based credit scoring (leewayhertz.com)
9. Responsible AI Credit Scoring – A Lesson from Upstart.com (degruyter.com)
10. How Fraud Detection Using AI in Banking Works? — Infosys BPM
11. How Is AI Used in Fraud Detection? — NVIDIA Blog
12. (2) (PDF) Deep Learning for Time Series Forecasting: A Survey (researchgate.net)

Evaluation Scheme:

Theory :

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 10 marks each will be conducted during the semester.
2. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Artificial Intelligence in Finance Laboratory (PEAI7042L)

Practical Scheme
Practical : 02 Hrs./week
Credit : 01

Examination Scheme
Teacher Assessment : 25 Marks
End Sem Exam : 25 Marks
Total : 50 Marks

Course Objectives:

1. Analyze and interpret financial data using Python libraries.
2. Develop and evaluate machine learning models for financial predictions.
3. Apply natural language processing techniques to financial news sentiment analysis.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Perform exploratory data analysis (EDA) on financial data using Python.	L3	Apply
CO2	Build and assess machine learning models for stock price prediction.	L5	Evaluate
CO3	Conduct sentiment analysis on financial news and assess its impact on stock prices.	L4	Analyze
CO4	Optimize a stock portfolio using algorithms and evaluate risk and return.	L6	Create

List of Laboratory Experiments

Suggested List of Experiments:

1. Case Study: Predicting Stock Prices with a Simple Neural Network
2. Exploratory Data Analysis (EDA) with Financial Data: Use Python libraries like Pandas and Matplotlib to analyze and visualize historical financial data. Identify trends, patterns, and correlations in stock prices, market indices, or other financial indicators.
3. Predictive Modelling for Stock Prices:Build machine learning models (e.g., linear regression, decision trees, or LSTM neural networks) to predict future stock prices based on historical data. Evaluate the performance of the models using metrics like mean squared error (MSE) or accuracy.
4. Sentiment Analysis of Financial News : Use natural language processing (NLP) techniques to analyze the sentiment of news articles or social media posts about specific stocks or companies. Determine the impact of sentiment on stock price movements.
5. Case Study: Research a historical example of a financial market crash. Analyze how AI might have influenced the event, for better or worse.
6. Portfolio Optimization: Develop an algorithm to optimize a portfolio of stocks based on risk and return objectives. Use techniques like mean-variance optimization or Monte Carlo simulation.
7. Credit Risk Assessment: Build a machine learning model to predict the creditworthiness of individuals or companies based on financial and non-financial data. Evaluate the model's performance using metrics like precision, recall, and F1-score.
8. Risk Management: Implement and backtest simple trading strategies (e.g., moving average crossover) using historical stock price data. Use Python libraries like Pandas and NumPy for data manipulation and strategy implementation.
9. Fraud Detection in Financial Transactions: Develop a fraud detection model using machine learning techniques to identify fraudulent transactions in a financial dataset. Evaluate the model's performance using metrics like precision, recall, and ROC-AUC.
10. Time Series Forecasting for Financial Data: Use time series forecasting models (e.g., ARIMA, Prophet) to predict future values of financial indicators like stock prices or exchange rates. Evaluate the accuracy of the forecasts using metrics like mean absolute error (MAE) or mean absolute percentage error (MAPE).

Any other experiment based on syllabus may be included, which would help the learner to understand topic/concept.

Evaluation Scheme:

Laboratory:

Continuous Assessment (A):

Laboratory work will be based on PEAI7042T with minimum 08 experiments to be incorporated. The distribution of marks for term work shall be as follows:

1. Performance in Experiments: 05 Marks
2. Journal Submission: 05 Marks
3. Viva-voce: 05 Marks
4. Subject Specific Lab Assignment/Case Study: 10 Marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

End Semester Examination (C):

Oral/ Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Artificial Intelligence in Cyber Security (PEAI7043T)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 10 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisite: Artificial Intelligence, Machine Learning and Computer Network.

Course Objectives:

1. An overview of different AI and Machine Learning models in Cyber Security.
2. Using Machine Learning for effective security.
3. Various attack on ML models.
4. Machine Learning and Privacy.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand the various concept of Cyber Security.	L2	Understand
CO2	Understand the concepts in AI and Machine Learning for Cyber security.	L2	Understand
CO3	Learn various AI and Machine learning models for cyber security.	L2	Understand
CO4	Ability to apply AI and machine learning models in cyber security issues.	L3,L4	Apply, Analyze

Course Contents

Unit-I — 07 Hrs.

Introduction to Cyber Security:

Basic Cyber Security Concepts, layers of security, Vulnerability, threat, Harmful acts, Internet Governance – Challenges and Constraints, Computer Criminals, CIA Triad, Assets and Threat, motive of attackers, active attacks, passive attacks, Software attacks, hardware attacks, Spectrum of attacks, Taxonomyof various attacks, IP spoofing, Methods of defense, SecurityModels, risk management, Cyber Threats-Cyber Warfare, Cyber Crime, Cyber terrorism, Cyber Espionage, etc., Comprehensive Cyber Security Policy.

Unit-II — 06 Hrs.

Artificial Intelligence in Cyber Security:

Role of AI in Cyber Security and Security Framework: Artificial Intelligence in Cyber Security, Challenges and Promises, Security Threats of Artificial Intelligence, Use-Cases: Artificial Intelligence Email Observing, ModelStealing & Watermarking, Network Traffic Analysis, Malware Analysis, United Family Healthcare by IBM.

Unit-III — 07 Hrs.

Machine Learning in Security:

Introduction to Machine Learning, Applications of Machine Learning in Cyber Security Domain, Machine Learning: tasks and Approaches, Anomaly Detection, Privacy Preserving Nearest Neighbour Search, Machine Learning Applied to Intrusion Detection, Online Learning Methods for Detecting Malicious Executables.

Unit-IV — 06 Hrs.

Deep Learning in Security:

Introduction to deep learning, Cyber Security Mechanisms Using Deep Learning Algorithms, Applying deeplearning in various use cases, Network Cyber threat Detection.

Unit-V — 07 Hrs.

Cyber Security: Organizational Implications:

Introduction, cost of cybercrimes and IPR issues, web threats for organizations, security and privacy implications, social media marketing: security risks and perils for organizations, social computing and the associated challenges for organizations. Cybercrime and Cyber terrorism: Introduction, intellectual property in the cyberspace, the ethical dimension of cybercrimes the psychology, mindset and skills of hackers and other cyber criminals.

Unit-VI 06 Hrs.

Trends in Cybersecurity:

Responding to Ransomware, Combining Application development and Cybersecurity, Using Deep Learning to Detect DGA-Generated Domains Detecting Non-Malware Threats. Adaptive Honeypots and Honey tokens, Gaining a Better Understanding of How Neural Networks Work, Employing, Capsule Networks, Deep Reinforcement Learning. Protecting the IoT, Predicting the Future.

Text Books:

1. Gupta, Brij B., and Quan Z. Sheng, eds., "Machine learning for computer and cyber security: principle, algorithms, and practices", CRC Press, 2019.
2. Neeraj Bhargava, Ritu Bhargava, Pramod Singh Rathore, Rashmi Agrawal, "Artificial Intelligence and Data Mining Approaches in Security Frameworks", Editor(s): 2021.
3. Leslie F. Sikos, "AI in Cybersecurity", Springer, 2018.
4. Nina Godbole and Sunit Belpure, "Cyber Security Understanding Cyber Crimes", Computer Forensics and Legal Perspectives, Wiley, 2018

Reference Books:

1. Alessandro Parisi, "Hands-On Artificial Intelligence for Cybersecurity: Implement smart AI systems for preventing cyber-attacks and detecting threats and network anomalies", Packt Publication, 2019.
2. Tsai, Jeffrey JP, and S. Yu Philip, eds., "Machine learning in cyber trust: security, privacy, and reliability", Springer Science & Business Media, 2009.
3. Kevin P Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press.
4. Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer 2006.

Web Links:

1. GPU Gen AI in Cybersecurity https://www.coursera.org/learn/gen-ai-in-cybersecurity

Evaluation Scheme:

Theory :

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 10 marks each will be conducted during the semester.

2. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 65 marks.

2. Total duration allotted for writing the paper is 3 hrs.

Artificial Intelligence for Cyber Security Laboratory (PEAI7043L)

Practical Scheme
Practical : 02 Hrs./week
Credit : 01

Examination Scheme
Teacher Assessment : 25 Marks
End Sem Exam : 25 Marks
Total : 50 Marks

Course Objectives:

1. Learn spam email detection, DDoS network traffic analysis and breaking Captchas with neural network.
2. Implement encoder and clustering algorithm ,Ensemble learning.
3. Implement Cyber security Threats detection with AI and Fraud Prevention with Cloud AI Solutions.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand of the machine learning pipeline for spam email detection. Time series analysis for DDoS network traffic analysis.	L2	Understand
CO2	Understanding deep learning and convolutional neural network for breaking Captchas with neural network. Dimensionality reduction and data visualization.	L2	Understand
CO3	Understand of the Auto encoder and clustering algorithm. Data oversampling and decision tree algorithm.	L2	Understand
CO4	Implement Ensemble learning, Detecting Cyber security Threats with AI, Fraud Prevention with Cloud AI Solutions.	L3	Apply

List of Laboratory Experiments

Suggested List of Experiments:

1. Python basics review and introduction of common data analysis libraries.
2. Machine learning pipeline for cybersecurity problems. Case study: spam email detection
3. Time series analysis
   (a) Case study: DDoS network traffic analysis
4. A small step into deep learning and convolutional neural network (CNN)
   (a) Case study: breaking Captchas with neural network
5. Dimensionality reduction and data visualization.
   (a) Case study: network anomaly detection and visualization
   (b) Dataset: KDD Cup 1999 dataset (We will reuse these in lab 6)
6. Auto encoder and clustering algorithm
7. Data oversampling and decision tree algorithm
   (a) Case study: detecting and categorizing network attacks
   (b) Dataset: Kaggle credit card fraud detection dataset
8. Ensemble learning
9. Detecting Cyber security Threats with AI
10. Fraud Prevention with Cloud AI Solutions

Any other experiment based on syllabus may be included, which would help the learner to understand topic/concept.

Evaluation Scheme:

Laboratory:

Continuous Assessment (A):

Laboratory work will be based on PEAI7043T with minimum 08 experiments to be incorporated. The distribution of marks for term work shall be as follows:

1. Performance in Experiments: 05 Marks
2. Journal Submission: 05 Marks

3. Viva-voce: 05 Marks

4. Subject Specific Lab Assignment/Case Study: 10 Marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

End Semester Examination (C):

Oral/ Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Product Life Cycle Management(OEAI7051T)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 10 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisite: Knowledge of basic concepts of Management

Course Objectives:

1. To familiarize the students with the need, benefits and components of PLM.
2. To acquaint students with Product Data Management & PLM strategies.
3. To give insights into new product development program and guidelines for designing and developing a product.
4. To familiarize the students with Virtual Product Development.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Gain knowledge about phases of PLM, PLM strategies and methodology for PLM feasibility study and PDM implementation.	L2	Understand
CO2	Illustrate various approaches and techniques for designing and developing products.	L3	Apply
CO3	Apply product engineering guidelines / thumb rules in designing products for moulding, machining, sheet metal working etc.	L3	Apply
CO4	Acquire knowledge in applying virtual product development tools for components, machining and manufacturing plant.	L2	Understand

Course Contents

Unit-I — 10 Hrs.

Introduction to Product Lifecycle Management (PLM): Product Lifecycle Management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance & Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications

PLM Strategies: Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy, Change management for PLM

Unit-II — 08 Hrs.

Product Design: Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models, Reference Model, Product Design in the Context of the Product Development Process, Relation with the Development Process Planning Phase, Relation with the Post design Planning Phase, Methodological Evolution in Product Design, Concurrent Engineering, Characteristic Features of Concurrent Engineering, Concurrent Engineering and Life Cycle Approach, New Product Development (NPD) and Strategies, Product Configuration and Variant Management, The Design for X System, Objective Properties and Design for X Tools, Choice of Design for X Tools and Their Use in the Design Process

Unit-III — 08 Hrs.

Product Data Management (PDM): Product and Product Data, PDM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation

Virtual Product Development Tools: For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model building, Model analysis, Modelling and simulations in Product Design, Examples/Case studies

Unit-IV — 08 Hrs.

Integration of Environmental Aspects in Product Design: Sustainable Development Design for Environment, Need for Life Cycle Environmental Strategies, Useful Life Extension Strategies, End-of-Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design.

Unit-V — 08 Hrs.

Life Cycle Assessment and Life Cycle Cost Analysis: Properties, and Framework of Life Cycle Assessment, Phases of LCA in ISO Standards, Fields of Application and Limitations of Life Cycle

Assessment, Cost Analysis and the Life Cycle Approach, General Framework for LCCA, Evolution of Models for Product Life Cycle Cost Analysis.

Text Books:

1. John Stark, "Product Lifecycle Management: Paradigm for 21st Century Product Realization", Springer-Verlag, 2004.

2. Guido La Rosa, Antonino Risitano, Taylor & Francis, "Product Design for the environment-A life cycle approach", Fabio Giudice, 2006.

Reference Books:

1. Saaksvuori Antti, Immonen Anselmie,"Product Life Cycle Management", Springer, Dreamtech, 2009.

2. Michael Grieve, "Product Lifecycle Management: Driving the next generation of lean thinking", Tata McGraw Hill, 2006.

3. François Villeneuve, Luc Mathieu, Max Giordano, "Product Life-Cycle Management: Geometric Variations", Wiley, 2010.

Evaluation Scheme:

Theory :

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 10 marks each will be conducted during the semester.

2. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 65 marks.

2. Total duration allotted for writing the paper is 3 hrs.

Management Information System (OEAI7052T)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 10 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisite: Knowledge of basic concepts of Management

Course Objectives:

1. The course is blend of Management and Technical field.
2. Discuss the roles played by information technology in today's business and define various technology architectures on which information systems are built.
3. Define and analyze typical functional information systems and identify how they meet the needs of the firm to deliver efficiency and competitive advantage.
4. Identify the basic steps in systems development.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain how information systems Transform Business.	L2	Understand
CO2	Identify the impact information systems have on an organization.	L3	Apply
CO3	Describe IT infrastructure and its components and its current trends.	L2	Understand
CO4	Understand the principal tools and technologies for accessing information from databases to improve business performance and decision making.	L2	Understand
CO5	Identify the types of systems used for enterprise-wide knowledge management and how they provide value for businesses.	L3	Apply

Course Contents

Unit-I — 05 Hrs.

Foundation Concepts: Information Systems in Business, Functional Area Information System, The Components of Information Systems, Impact of IT on organizations and society, Organizational Strategy, Information systems for strategic advantage.

Unit-II — 08 Hrs.

Information Technologies: Hardware and Software

Computer Systems: End User and Enterprise Computing

Computer Peripherals: Input, Output, and Storage Technologies

Application Software: End User Applications

System Software: Computer System Management

Data Resource Management: Technical Foundations of Database Management, Managing Data Resources, Big data, Data warehouse and Data Marts, Knowledge Management

Networks: The Networked Enterprise (Wired and wireless), Pervasive computing, Cloud Computing models

Unit-III — 08 Hrs.

MIS Tools and applications for Decision making: ERP and ERP support of Business Process Reengineering

Business intelligence (BI): Managers and Decision Making, BI for Data analysis and Visualization

Artificial Intelligence Technologies in Business

Unit-IV — 06 Hrs.

Security and Ethical Challenges: Security, Ethical, and Societal Challenges of IT Security Management of Information Technology.

Unit-V — 07 Hrs.

Social Computing (SC): Web 2.0 and 3.0, SC in business-shopping, Marketing, Operational and Analytic CRM, E-business and E-commerce – B2B B2C, Mobile commerce.

Unit-VI — 08 Hrs.

Information System within Organization: Acquiring Information Systems and Applications, Various System development life cycle models.

Enterprise and Global Management of Information Technology: Managing Information Technology, Managing Global IT.

Reference Books:

1. James A O'Brien, George M., Ramesh Behl,"Management Information Systems", 11^{th} Edition, Tata McGraw Hill, 2019.
2. Kelly Rainer, Brad Prince,"Management Information Systems", 2^{nd} Edition, Wiley, 2013.
3. K.C. Laudon and J.P. Laudon, "Management Information Systems: Managing the Digital Firm", 10^{th} Edition, Prentice Hall, 2007.
4. D. Boddy, A. Boonstra,"Managing Information Systems: Strategy and Organization", Prentice Hall, 2008. Prepared

Evaluation Scheme:

Theory :

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 10 marks each will be conducted during the semester.
2. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Operations Research (OEAI7053T)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 10 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisite: Basic Knowledge of Algebra, Probability and Statistics

Course Objectives:

1. To formulate a real-world decision problem as a mathematical programming model.
2. To learn the mathematical tools that are employed to solve mathematical programming models.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Convert a real-world problem into a Linear Programming Problem and analyse the solution obtained using Simplex method or other algorithms.	L4	Analyze
CO2	Identify real-world problems as Transportation Problem and Assignment Problem and Solve the decision problem by choosing appropriate algorithm.	L3	Apply
CO3	Identify the decision situations which vary with time and analyse them using principle of dynamic programming to real life situations.	L3	Apply
CO4	Explain reasons of formation of queues, classify various queuing systems and apply parameters defined for various queuing systems for decision making in real life situations.	L2	Understand
CO5	Understand the concept of decision making in situation of competition and recommend strategies in case of two-person zero sum games.	L2	Understand
CO6	Describe concept of simulation and apply Monte Carlo Simulation technique to systems such as inventory, queuing and recommend solutions for them.	L2	Understand
CO7	Understand need for right replacement policy and determine optimal replacement age.	L2	Understand

Course Contents

Unit-I — 10 Hrs.

Introduction to Operations Research: Concept of decision making. Definition of OR. Formulation of decision problem as OR model, Concept of Optimization

Linear Programming Problem: Mathematical Formulation. Finding optimal solution - Graphical method, Simplex Method, Big M-method, Two Phase Method. Duality, Primal – Dual construction, Symmetric and Asymmetric Dual. Dual Simplex Method.

Unit-II — 08 Hrs.

Assignment Problems: Mathematical Formulation, Finding optimal solution - Hungarian Method

Transportation problem: Mathematical Formulation, Finding initial basic feasible solution – Northwest corner rule, row minima, column minima, least cost method and Vogel's approximation method. Optimality test: the stepping stone method and MODI method. Improving the solution.

Unit-III — 06 Hrs.

Dynamic Programming: Bellman's Principle of optimality - Applications of dynamic programming- Employment smoothening problem, capital budgeting problem, shortest path problem, cargo loading problem

Unit-IV — 10 Hrs.

Queuing Models: Characteristics of queuing models. Single Channel – Single and multi phase servers, Poisson arrivals, exponential service time - with infinite population and finite population models – with infinite and finite capacity.

Multichannel – Single phase server - Poisson arrivals, exponential service time with infinite population.

Game Theory: Introduction. Minimax & Maximin Criterion and optimal strategy. Solution of games with saddle points, rectangular games without saddle points - 2 x 2 games, dominance principle.

Approximate methods - Iterative method, m x 2 & 2 x n games -Graphical method and method of sub-games. Expressing game as LPP.

Unit-V — 08 Hrs.

Simulation: Definition. Types of simulation models. Monte Carlo simulation technique. Applications of simulation - Inventory and Queuing problems. Simulation Languages.

Replacement Models: Replacement of items that deteriorate with time - when money value is not counted and counted. Replacement of items that fail suddenly – individual and group replacement

policy.

Note: Educator is expected to introduce relevant software available for solving various mathematical models.

Text Books:

1. Sharma J. K.,"Operations Research", Trinity Press.
2. Gupta P. K., Hira D. S.,"Operations Research", S. Chand Limited.

Reference Books:

1. Taha, H.A."Operations Research - An Introduction", Prentice Hall
2. Ravindran, A, Phillips, D. T and Solberg, J. J.,"Operations Research: Principles and Practice", John Willey and Sons
3. Hiller, F. S. and Liebermann, G. J.,"Introduction to Operations Research", Tata McGraw Hill
4. Pradeep Prabhakar Pai,"Operations Research Principles and Practice", Oxford University Press
5. R. Panneerselvam, "Operations Research", PHI Publications.
6. A. M. Natarajan, P. Balasubramani, A. Tamilarasi,"Operations Research", Pearson Education.
7. Kanti Swarup, P. K. Gupta and Man Mohan,"Operations Research", Sultan Chand & Sons.

Evaluation Scheme:

Theory :

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 10 marks each will be conducted during the semester.
2. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Cyber Security and Laws(OEAI7054T)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 10 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisite: Knowledge of basic concepts of security

Course Objectives:

1. To understand and identify different types cybercrime and cyber offences.
2. To recognized Indian IT Act 2008 and its latest amendments.
3. To learn various types of security standards compliances.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand the different types of cybercrime and security issues E Business.	L2	Understand
CO2	Analyses different types of cyber threats and techniques for security management.	L4	Analyze
CO3	Explore the legal requirements and standards for cyber security in various countries to regulate cyberspace.	L4	Analyze
CO4	Impart the knowledge of Information Technology Act and legal frame work of right to privacy, data security and data protection.	L2	Understand

Course Contents

Unit-I — 12 Hrs.

Introduction to Cybercrime: Cyber Crime, Cyber Law, Cyber Security, History of Cyber Crime, Hacking, Data Theft, Cyber Terrorism, Virus & Worm's, Email Bombing, Pornography, online gambling, Forgery, Web Defacements, Web Jacking, Illegal online Selling, Cyber Defamation, Software Piracy, Electronics/ Digital Signature, Phishing, Password Cracking, Key loggers and Spywares, Steganography, DoS and DDoS attacks, SQL Injection, Buffer Over Flow, Attacks on Wireless Networks, Phishing Identity Theft (ID Theft)

Cyber offenses: How criminal plan the attacks, Social Engineering, Cyber stalking, Cyber café and Cybercrimes, Botnets, Attack vector

Unit-II — 08 Hrs.

Cyber Threats Analysis: Knowledge of Dynamic and Deliberate Targeting

Knowledge of Indications and Warning

Knowledge of Internal Tactics to Anticipate and/or, Emulate Threat Capabilities and Actions

Knowledge of Key Cyber Threat Actors and their Equities

Knowledge of Specific Target Identifiers and Their Usage

Cyber Security Management:

Knowledge of Emerging Security Issues, Risks, and Vulnerabilities

Unit-III — 06 Hrs.

Electronic Business and legal issues:

Evolution and development in Ecommerce, Policy Frameworks for Secure Electronic Business, paper vs paper less contracts, E-Commerce models- B2B, B2C, E security. E-Payment Mechanism; Payment through card system, E-Cheque, E-Cash, E-Payment Threats & Protections, Security for E-Commerce.

Unit-IV — 08 Hrs.

Indian IT Act: Cyber Crime and Criminal Justice, Penalties, Adjudication and Appeals Under the IT Act, 2000, IT Act. 2008 and its Amendments

Security aspect in cyber Law: The Contract Aspects in Cyber Law, The Security Aspect of Cyber Law, The Intellectual Property Aspect in Cyber Law, The Evidence Aspect in Cyber Law, The Criminal Aspect in Cyber Law

Unit-V — 08 Hrs.

Security Industries Standard Compliances:

IT Security v/s IT Compliance, Cyber Security Standards, critical security controls for cyber security, GRC (Governance, Risk Management, and Compliance), SOX, GLBA, HIPAA, ISO/IEC 27001, NIST Cyber Security Framework (CSF), PCI-DSS.

OWASP Top Ten Project, GDPR (General Data Protection Regulation), NIST (National Institute of Standards and Technology), CIS Controls (Center for Internet Security Controls)

Reference Books:

1. Nina Godbole, Sunit Belapure, "Cyber Security", Wiley India, New Delhi.
2. Suresh T. Vishwanathan, "The Indian Cyber Law",Bharat Law House New Delhi.
3. "The Information Technology Act", Bare Act- Professional Book Publishers, New Delhi, 2000.
4. Anup K. Ghosh, "E-Commerce Security and Privacy", Springer Science and Business Media, 2012.
5. Izzat Alsmadi, "The NICE Cyber Security Framework Cyber Security Intelligence and Analytics", Springer.
6. Advocate Prashant Mali,"Cyber Law & Cyber Crimes", Snow White Publications, Mumbai
7. Nina Godbole, "Information Systems Security", Wiley India, New Delhi.
8. Kennetch J. Knapp, "Cyber Security & Global Information Assurance" Information Science Publishing.
9. William Stallings, "Cryptography and Network Security", Pearson Publication

Web Links:

1. The Information Technology ACT, 2008- TIFR : https://www.tifrh.res.in
2. A Compliance Primer for IT professional: https://www.sans.org/reading-room/whitepapers/compliance/compliance-primer- professionals-33538

Evaluation Scheme:

Theory :

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 10 marks each will be conducted during the semester.
2. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 65 marks.

2. Total duration allotted for writing the paper is 3 hrs.

Personal Finance Management(OEAI7055T)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 10 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisite: Basic Knowledge of Algebra, Probability and Statistics

Course Objectives:

1. To create awareness and educate consumers on access to financial services.
2. To make the students understand the basic concepts, definitions and terms related to direct taxation.
3. To help the students compute the Goods and Service Tax (GST) payable by a supplier after considering the eligible input tax credit.
4. To familiarize the students with microfinance for accelerating the expansion of local microbusinesses.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Use a framework for financial planning to understand the overall role finances play in his/her personal life.	L3	Apply
CO2	Compute income from salaries, house property, business/profession, capital gains and income from other sources.	L3	Apply
CO3	Compute the amount of CGST, SGST and IGST payable after considering the eligible input tax credit.	L3	Apply
CO4	Understand how Microfinance can help in financial inclusion.	L2	Understand

Course Contents

Unit-I — 07 Hrs.

Overview of Indian Financial System: Characteristics, Components and Functions of Financial System. Financial Instruments and Financial Markets, Financial inclusion.

Introduction to Personal Finance: Person Financial Planning in Action, Money Management Skills, Taxes in Your Financial Plan, Savings and Payment Services.

Consumer Credit: Advantages, Disadvantages, Sources and Costs.

Unit-II — 07 Hrs.

Personal Financial Management:

Loans: Home, Car, Education, Personal, Loan against property and Jewel loan.

Insurance: Types of Insurance – ULIP and Term; Health and Disability Income Insurance, Life Insurance.

Investment: Investing Basics and Evaluating Bonds, Investing in Stocks and Investing in Mutual Funds, Planning for the Future.

Unit-III — 08 Hrs.

Income Tax:

Income Tax Act Basics: Introduction to Income Tax Act, 1961

Heads of Income and Computation of Total Income and Tax Liability: Heads of Income and Computation of Total Income under various heads, Clubbing Provisions, Set off and Carry forward of Losses, Deductions, Assessment of Income and tax liability of different persons.

Tax Management, Administrative Procedures and ICDS: TDS, TCS and Advance Tax Administrative Procedures, ICDS.

Unit-IV — 10 Hrs.

Goods and Services Tax: GST Constitutional framework of Indirect Taxes before GST (Taxation Powers of Union & State Government); Concept of VAT: Meaning, Variants and Methods; Major Defects in the structure of Indirect Taxes prior to GST; Rationale for GST; Structure of GST (SGST, CGST, UTGST & IGST); GST Council, GST Network, State Compensation Mechanism, Registration.

Levy and Collection of GST: Taxable event- "Supply" of Goods and Services; Place of Supply: Within state, Interstate, Import and Export; Time of supply: Valuation for GST- Valuation rules, taxability of reimbursement of expenses; Exemption from GST: Small supplies and Composition Scheme: Classification of Goods and Services

Unit-V 10 Hrs.

Introduction to Micro – finance: Micro-Finance: Definitions, Scope & Assumptions, Types of Microfinance, Customers of Micro-finance, Credit Delivery Methodologies, SHG concept, origin, Formation & Operation of Self Help Groups (SHGs).

Models in Microfinance: Joint Liability Groups (JLG), SHG Bank Linkage Model and GRAMEEN Model: Achievements & Challenges

Institutional Mechanism: Current Challenges for Microfinance, Microfinance Institutions (MFIs): Constraints & Governance Issues, Institutional Structure of Microfinance in India: NGO-MFIs, NBFC-MFIs, Co-operatives, Banks, Microfinance Networks and Associations; Demand & Supply of Microfinance Services in India, Impact assessment and social assessments of MFIs.

Reference Books:

1. Asha Singh, M.S. Gupta, "Banking and Financial Sector Reforms in India" , Serials Publication.
2. M.S. Gupta & J.B. Singh,"Indian Banking Sector: Essays and Issues",1st Edition, Serials Publication.
3. K.M. Bhattacharya O.P. Agarwal,"Basics Of Banking & Finance", Himalaya Publishing House.
4. S. Subba Reddy , P. Raghu Ram, "Agricultural Finance And Management".
5. Dr.Vasant Desai, "The Indian Financial System And Development", 4th Edition, Himalaya Publishing House.
6. Sanjay Kumar Satapathy, "Income Tax Management Simple Way of Tax Management, Tax Planning and Tax Saving".
7. Dr. R. K. Jain, "Direct Tax System Income Tax", SBPD Publications.
8. S K Mishra,"Simplified Approach to GST Goods and Services Tax", Educreation Publishing.
9. Todd A Watkins, "Introduction To Microfinance", World Scientific Publishing Company.

Evaluation Scheme:

Theory :

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 10 marks each will be conducted during the semester.
2. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Energy Audit and Management(OEAI7056T)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 10 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Course Objectives:

1. To understand the importance of energy security for sustainable development and the fundamentals of energy conservation.
2. To identify and describe the basic principles and methodologies adopted in energy audit of a utility
3. To introduce performance evaluation criteria of various electrical and thermal installations to facilitate the energy management.
4. To relate the data collected during performance evaluation of systems for identification of energy saving opportunities.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	To identify and describe present state of energy security and its importance.	L2, L3	Understand, Apply
CO2	To identify and describe the basic principles and methodologies adopted in energy audit of a utility.	L2, L3	Understand, Apply
CO3	To describe the energy performance evaluation of some common electrical installations and identify the energy saving opportunities.	L2	Understand
CO4	To describe the energy performance evaluation of some common thermal installations and identify the energy saving opportunities.	L2	Understand
CO5	To analyze the data collected during performance evaluation and recommend energy saving measures.	L4	Analyze

Course Contents

Unit-I — 05 Hrs.

Energy Scenario: Present Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy Security, Energy Conservation and its Importance, Energy Conservation Act- 2001 and its Features. Basics of Energy and its various forms, Material and Energy balance.

Unit-II — 10 Hrs.

Energy Audit: Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution. Elements of monitoring & targeting, Energy audit instruments. Technical and economic feasibility, Classification of energy conservation measures. Safety considerations during energy audit.

Financial analysis techniques: Simple payback period, NPV, Return on investment(ROI) Internal rate of return (IRR).

Unit-III — 10 Hrs.

Energy Management and Energy Conservation in Electrical System: Electricity billing, Electrical load management and maximum demand Control; Power factor improvement, Energy efficient equipments and appliances, star ratings. Energy efficiency measures in lighting system, lighting control: Occupancy sensors, daylight integration, and use of intelligent controllers. Energy conservation opportunities in water pumps, compressor, fan and blower. industrial drives, induction motors, motor retrofitting, soft starters, variable speed drives

Unit-IV — 10 Hrs.

Energy Management and Energy Conservation in Thermal Systems: Review of different thermal loads; Energy conservation opportunities in: Steam distribution system, Steam leakages, Steam trapping, Condensate and flash steam recovery system. Waste heat recovery, use of insulation-types and application. Energy conservation opportunities in: Boiler system. Refrigeration system and HVAC system.

Unit-V — 07 Hrs.

Energy conservation in Buildings: Energy Conservation Building Codes (ECBC); Green Building, LEED rating, Application of Non-Conventional and Renewable Energy Sources, Energy [illegible] and energy management in electric vehicles.

Reference Books:

1. Geofry Stokes,"Handbook of Electrical Installation Practice", Blackwell Science.
2. Anil Valia, "Designing with light: Lighting Handbook", Lighting System.
3. W.C. Turner, "Energy Management Handbook", John Wiley and Sons.
4. A. K. Tyagi,"Handbook on Energy Audits and Management", Tata Energy Research Institute (TERI).
5. C.B. Smith,"Energy Management Principles", Pergamon Press.
6. Dale R. Patrick, S. Fardo, Ray E. Richardson, "Energy Conservation Guidebook", Fairmont Press.
7. Albert Thumann, W. J. Younger, T. Niehus, "Handbook of Energy Audits", , CRC Press.

Web Links:

1. www.energymanagertraining.com
2. www.bee-india.nic.in

Evaluation Scheme:

Theory :

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 10 marks each will be conducted during the semester.
2. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Disaster Management and Mitigation Measures(OEAI7057T)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 10 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Course Objectives:

1. To provide basic understanding hazards, disaster and various types and categories of disaster occurring around the world.
2. To identify extent and damaging capacity of a disaster.
3. To study and understand the means of losses and methods to overcome /minimize it.
4. To understand roles and responsibilities of individual and various organization during and after disaster.
5. To appreciate the significance of GIS, GPS in the field of disaster management.
6. To understand the emergency government response structures before, during and after disaster

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Know natural as well as manmade disaster and their extent and possible effects on the economy.	L2	Understand
CO2	Know the institutional framework and organization structure in India for disaster management and get acquainted with government policies, acts and various emergency laws.	L2	Understand
CO3	Get to know the simple do's and don'ts in such extreme events and build skills to respond accordingly.	L2, L3	Understand, Apply
CO4	Understand the importance of disaster prevention and various mitigation measure with the exposure to disasters hotspots across the globe.	L2	Understand

Course Contents

Unit-I — 10 Hrs.

General Information about Disaster: Brief concept of Hazards, definition and types of Disasters – Natural, Man-made, and hybrid, Groups of Disasters- Natural and Technological, global Scenario, Significance of studying various aspects of disasters, effects of disasters, India's vulnerability to disasters, Impact of disaster on National development.

Study of Natural disasters:

Flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion etc.

Study of Human/Technology Induced Disasters:

Chemical, Industrial and Nuclear disasters, Internally displaced persons, road and train accidents Fire Hazards, terrorism, militancy, Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters.

Unit-II — 08 Hrs.

Disaster Management: Brief Introduction, Disaster management cycle, Evolution of Disaster and Disaster management in India, Disaster management acts, policies and guidelines, laws of emergencies etc.

Prior, During and Post disaster management activities: Preparedness, strengthening emergency centers, Logistics, optimum resource management, emergency response and relief, Training, Public awareness, Research, Reconstruction of essential services and livelihood restoration.

Unit-III — 08 Hrs.

Institutional framework and Mechanism for disaster management in India: Institutions in India for dealing with various disasters, Organizational structure, functions and responsibilities of National Institute of Disaster Management (NIDM) and National disaster management authority (NDMA) in India, roles and responsibilities of central and state government during and after disaster, NGO's involved in disasters and their task, Jobs carried out by armed forces, Financial Relief During disaster (State, National and International Disaster Assistance)

Unit-IV — 08 Hrs.

Disaster risk reduction and Mitigation Measures: Need of disaster prevention and mitigation, mitigation guiding principles, challenging areas, structural and non-structural measures for disaster risk reduction.

Mitigation measures for flood, earthquake, cyclone monitoring, air quality, water quality, climate change, land use, winter storms and aquatic biology etc.

Use of information management, GIS, GPS and remote sensing Mitigation measure. Do's and don'ts in case of disasters and effective implementation of relief aids.

Unit-V 08 Hrs.

Case studies on disaster (National /International): Case study discussion of Hiroshima – Nagasaki (Japan), India – Tsunami (2004) , Bhopal gas tragedy, Kerala and Uttarakhand flood disaster, Cyclone Phailin (2013), Fukushima Daiichi nuclear disaster (2011), 26th July 2005 Mumbai flood, Chernobyl meltdown and so on. (Discuss case studies on disaster with respect to reason for the disaster, incidents, effects of disaster, present scenario and safety measures taken)

Reference Books:

1. Harsh K.Gupta,"Disaster Management", Universities Press Publications (2003).
2. O.S.Dagur, "Disaster Management: An Appraisal of Institutional Mechanisms in India", published by Centre for land warfare studies, New Delhi, 2011.
3. Damon Copolla,"Introduction to International Disaster Management", Butterworth Heinemann Elsevier Publications (2015).
4. Jack Pinkowski, "Disaster Management Handbook", CRC Press, Taylor and Francis group (2008).
5. Rajdeep Dasgupta, "Disaster management & rehabilitation", Mittal Publications, New Delhi (2007).
6. R B Singh,"Natural Hazards and Disaster Management, Vulnerability and Mitigation", Rawat Publications (2006).
7. C.P.Lo Albert, K.W. Yonng, "Concepts and Techniques of GIS", Prentice Hall (India) Publications (2006).
8. Claudia G. Flores Gonzales, "Risk management of natural disasters", KIT Scientific Publishing (2010).
9. W. Nick Carter, "Disaster Management – a disaster manger's handbook", Asian Development Bank (2008).
10. R. K. Srivastava, "Disaster Management in India", Ministry of Home Affairs, GoI, New Delhi (2011)
11. Wil Mara,"The Chernobyl Disaster: Legacy and Impact on the Future of Nuclear Energy", Marshall Cavendish Corporation, New York, 2011.
12. Ronald Eisler,"The Fukushima 2011 Disaster", Taylor & Francis, Florida, 2013. (Learners are expected to refer reports published at national and international level and updated information available on authentic web sites)

Evaluation Scheme:

Theory :

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 10 marks each will be conducted during the semester.
2. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Science of Well-being (OEAI7058T)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 10 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Course Objectives:

1. To create consciousness about importance of holistic health and physical as well as mental well-being.
2. To make learners aware of the concepts of Happiness, Gratitude, Self-Compassion, Empathy etc.
3. To introduce the learners to the means of mental and physical well-being, ill effects of mal-practices like alcoholism, smoking etc.
4. To equip the learners to manage and cope up with stress in their daily living.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Describe concepts of holistic health and well-being, differentiate between its true meaning and misconceptions and understand the benefits of well-being.	L2	Understand
CO2	Recognize meaning of happiness, practice gratitude and self-compassion and analyze incidents from one's own life.	L4	Analyze
CO3	Understand the causes and effects of stress, identify reasons for stress in one's own surrounding and self.	L1,L2	Remember, Understand
CO4	Recognize the importance of physical health and fitness, assess their life style and come up with limitations or effectiveness.	L5	Evaluate
CO5	Inspect one's own coping mechanism, assess its effectiveness, develop and strategize for betterment and execute it.	L4	Analyze

Course Contents

Unit-I — 06 Hrs.

Health and well-being: The concept of health, dimensions of health, the notion of well- being, various facets of well-being, relation between health and well-being. Concept of holistic health, its principles and importance, concept and benefits of holistic care, misconceptions about holistic health approach, the application of a true holistic approach to our well-being.

Unit-II — 08 Hrs.

Concepts of happiness: Happiness: what is it and how do we measure it? Philosophical perspectives on happiness, Happiness: Nature or Nurture? Happiness in the modern world: impediments and accelerators, Narrow vs. Broad Band Approaches to Happiness, Benefits of Happiness, Self-Compassion and Gratitude. Misconceptions of happiness.

Unit-III — 10 Hrs.

Stress and mental health/well-being: Nature and concept of stress, meaning and definitions of stress, types of stress, meaning of stressors, types of stressors, symptoms of stress, effects of stress, different models of stress.

Sources of stress and how does stress cause illness, various sources of stress, delineate between external and internal sources of stress, differentiate between continuous and discrete stressors, the effects of these stressors on health and well-being, diversity of stressors and their health consequences, relation between stress and illness from different perspectives association between stress related physiological mechanisms and different illnesses.

Unit-IV — 10 Hrs.

Physical Well-being / Health management: concept of health behaviours, dimensions of health behaviours. Health enhancing behaviors: Exercise and Weight control, application and importance of these health enhancing behaviours. Health protective behaviors and illness management: concept of illness management, effectiveness of illness management. Concept of Nutrition, Role of Nutrition, Components of Nutrition, concept of Malnutrition, Health compromising behaviours: Alcoholism, Smoking and its effects on health.

Unit-V — 08 Hrs.

Dealing with Difficult Times / Coping mechanisms: The concept of chronic stress, Health and safety risks of chronic stress, Forms and Treatment of chronic stress, Coping with Acute and Episodic stress, theories of the stress-illness link, role of stress in mental disorders.

Concept of coping, Ways of coping and stress management, basic knowledge about stress management

various techniques of stress management, stress management programs. Mental strengths and virtues, Hope, Optimism, Resilience – concept, pathways and models, Meditation and Self-introspection.

Text Books:

1. Felicia Huppert, Nick Baylis, Barry Keverne, "The Science of well-being", Oxford University Press.
2. S. Ojha, U. Rani Srivastava, Shobhna Joshi, "Health and Well-Being: Emerging Trends", Global Vision Publishing House.
3. Shane J. Lopez, Jennifer Teramoto Pedrotti, Charles Richard Snyder,"Positive psychology: The scientific and practical explorations of human strengths", Sage Publications.

Reference Books:

1. Kitayama, S.and Markus, H. R,"The pursuit of happiness and the realization of sympathy: Cultural patterns of self, social relations, and well-being", Culture and subjective well-being", The MIT Press.
2. Dubos, R, "Man Adapting", New Haven: Yale University Press.
3. McMahon D. M., "Happiness a history", Atlantic Monthly Press.
4. D. Kahneman & E. Diener & N. Schwarz, "Well-being: The foundations of hedonic psychology", New York: Russell Sage
5. Selye H., "The Stress of Life", New York, McGraw-Hill,1984.

Evaluation Scheme:

Theory :

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 10 marks each will be conducted during the semester.
2. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Research Methodology(OEAI7059T)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 10 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisite: Basic Knowledge of Probability and Statistics.

Course Objectives:

1. To understand Research and Research Process.
2. To acquaint learners with identifying problems for research and develop research strategies.
3. To familiarize learners with the techniques of data collection, analysis of data and interpretation.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Prepare a preliminary research design for projects in their subject matter areas.	L2, L3	Understand, Apply
CO2	Accurately collect, analyze and report data.	L4	Analyze
CO3	Present complex data or situations clearly.	L2	Understand
CO4	Review and analyze research findings.	L4	Analyze
CO5	Write report about findings of research carried out.	L3	Apply

Course Contents

Unit-I 07 Hrs.

Basic Research Concepts: Meaning of research, Objectives of research, Types of research, Significance of research Research process

Unit-II 10 Hrs.

Research Methodology: Identification of research problem, Literature review, Formulation of hypothesis, Formulation of Research design.

Unit-III 10 Hrs.

Research and Sample Design: Meaning of research and sample design, Need of research design, Features of good research design, Important concepts, Different research designs, Types of sampling designs.

Unit-IV 10 Hrs.

Data Collection and Data Analysis: Types of data, Methods for collecting data: Experiments and surveys, Collection of primary and secondary data, Hypothesis testing and interpretation of Data

Unit-V 05 Hrs.

Interpretation and Report Writing: Interpretation and drawing conclusions on the research, Preparation of the report, Ethical Issues

Reference Books:

1. Dawson, Catherine, "Practical Research Methods", New Delhi, UBS Publishers Distributors, 2002,.
2. Kothari, C.R.,"Research Methodology-Methods and Techniques", New Delhi, Wiley Eastern Limited, 1985.
3. Kumar, Ranjit, 2005, "Research Methodology-A Step-by-Step Guide for Beginners", 2nd Edition, Singapore, Pearson Education.

Evaluation Scheme:

Theory :

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 10 marks each will be conducted during the semester.
2. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Public Systems and Policies (OEAI70510T)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 10 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisite: Basic Knowledge of Social science and Current affairs.

Course Objectives:

1. To analyze the transformations in public systems with emphasis on current initiatives and emerging challenges in the field.
2. To understand public systems in a fast-changing environment in the global context.
3. To provide an in-depth understanding of the ills prevailing in the society and aids to identify the solutions for them.
4. To explain public policy and its operations with special focus on policy relating to Government finance.
5. To analyze and evaluate the impact of the public policy on firms and economy at large.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand the importance of public systems in a fast-changing environment in the global context.	L2	Understand
CO2	Analyze the transformations in public systems with emphasis on current initiatives and emerging challenges in the field.	L4	Analyze
CO3	Explain public policy and its operations with special focus on policy relating to Government finance.	L2	Understand
CO4	Make policies and know about the happenings in the world, in the nation and those in their locality.	L3	Apply
CO5	Analyze and evaluate the impact of the public policy on firms and economy at large and work under various fields as policymakers.	L4	Analyze

Course Contents

Unit-I — 10 Hrs.

Introduction and Overview of Public Systems: Ideology of Public Systems; Mechanistic and Organic view of Society and Individuals, The Legal Framework; Federal Government; State and Local Governments; Government growth; The size of Government.

Unit-II — 06 Hrs.

Public Sector in the Economics Accounts: Public Sector in the circular flow; Public Sector in the National Income Accounts.

Unit-III — 08 Hrs.

Public Choice and Fiscal Politics: Direct Democracy; Representative Democracy; The Allocation Function; The Distribution Function; The Stabilization Function; Coordination of Budget Functions; The Leviathan Hypothesis.

Unit-IV — 12 Hrs.

Introduction and Overview of Public Policy: Markets and Government; Social goods and Market failure, Public expenditure and its evaluation; Cost Benefit Analysis, Public policy and Externalities, Taxation Policy and its impact, Income distribution, redistribution and social security issues Fiscal & Budgetary Policy, Fiscal Federalism in India.

Unit-V — 06 Hrs.

Case Studies in Expenditure Policy: Public Services

A) National Defense B) Highways C) Outdoor Recreation D) Education

Reference Books:

1. Charles Wheelan, "Introduction to Public Policy", W.W. Norton & Company.
2. Thomas R. Dye, "Understanding Public Policy", Prentice Hall.
3. Anderson J.E.,"Public Policy-Making: An Introduction", Boston, Houghton.
4. Avasthi & Maheshwari, "Public Administration", Lakshminarayan Agarwal, Agra.
5. Bhattacharya, Mohit, "New Horizons of Public Administration", Jawahar Publishers, New Delhi.
6. Henry, Nicholas,"Public Administration and Public Affairs", Prentice Hall of India, New Delhi.
7. Harvey S Rosen and Ted Gayer, "Public Finance", 10th Edition, McGraw-Hill Education.

8. Musgrave and Musgrave, "Public Finance in Theory and Practice".

Evaluation Scheme:

Theory :

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 10 marks each will be conducted during the semester.
2. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Project Stage-II (PJAI7060L)

Practical Scheme
Practical : 08 Hrs./week
Credit : 04

Examination Scheme
Teacher Assessment : 25 Marks
End Sem Exam : 25 Marks
Total : 50 Marks

Course Objectives:

- To implement the solution as per the problem statement.
- To develop the team building, writing, logical reasoning and management skills.
- To provide the connections between the designs and concepts across different disciplinary boundaries.
- To encourage students to become independent personnel, critical thinkers and lifelong learners

Course Outcomes:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Apply engineering knowledge to produce solution of a problem considering cultural, social, environmental, and economic factors using appropriate tool and method.	L4	Analyze
CO2	Demonstrate project based learning that allows students to transfer existing ideas into new applications.	L2	Understand
CO3	Develop an ability to work in teams and manage the conduct of the research study.	L3	Apply
CO4	Integrate different perspectives from relevant disciplines which help them to get internships, jobs and admission for higher studies.	L3	Apply
CO5	Present the research in the form of technical writing, understand what constitutes to plagiarism and how to use proper referencing styles.	L2	Understand

Syllabus:

Project-I work done in VI semester shall be continued as Project-II in semester VII.

Students should complete remaining implementation of ideas given in synopsis/Abstract of semester VI.

Students / group must plan their execution of project, so that project work should be completed before end of semester.

Project-II involves fabrication, design, experimentation, data analysis within realistic constraints such as economic, environmental, social, ethical, health and safety, manufacturability, and sustainability. The stage also includes testing, possible results and report writing.

Each project group is required to maintain log book for documenting various activities of Project-II and submit group project report at the end of Semester-VII in the form of Hard bound.

Domain knowledge (any beyond) needed from the various areas in the field of AIML for the effective implementation of the project.

The above areas can be updated based on the technological innovations and development needed for specific project.

Guidelines:

The main purpose of this activity is to improve the students' technical skills, communication skills by integrating writing, presentation and teamwork opportunities.

Each group will be reviewed twice in a semester and marks will be allotted based on the various points mentioned in the evaluation scheme.

In the first review of this semester, each group is expected to complete 70% of project.

In the second review of this semester, each group is expected to complete 100% of project.

The students may use this opportunity to learn different computational techniques towards development of a product.

Interaction with alumni mentor will also be appreciated for the improvement of project.

Assessment Criteria:

- At the end of the semester, after confirmation by the project guide, each project group will submit project completion report in prescribed format for assessment to the departmental committee (including project guide).
- Assessment of the project (at the end of the semester) will be done by the departmental committee (including project guide).
- The candidate must bring the Project Stage-I report and the final report completed to all respo while appearing for End Semester Examination.
- Oral examination should be conducted by Internal and External examiners. Stude give presentation and demonstration based on their project.

Prescribed project report guidelines:

Every group should prepare hard bound report (preferrable LaTeX) of about minimum 40 pages on the work carried out by a batch of students in respect of the project work done during semester-VII. Project Report should include appropriate content for:

- Title
- Abstract
- Introduction
- Problem identification and project objectives
- Literature Survey
- Related Theory
- Project design and Implementation details
- Case study/Analysis/Design Methodology
- Project Outcomes
- Result and Conclusion
- Future scope
- References

Assessment criteria for the departmental committee (including project guide) for Continuous Assessment:

Guide will monitor weekly progress and marks allocation will be as per Table 2.

Table 1: Log Book Format

Sr	Week (Start Date:End Date)	Work Done	Sign of Guide	Sign of Coordinator
1				
2				

Table 2: Continuous Assessment Table

Sr	Exam Seat No	Name of Student	Student Attendance	Log Book Maintain	Literature Review	Depth of Understanding	Report	Total
			5	5	5	5	5	25

Assessment criteria for the departmental committee (including project guide) for ESE Semester Exam:

Each group will be reviewed twice in a semester by faculty guide and faculty coordinator based on the following criteria:

- Project progress
- Documentation/Technical paper writing
- Key findings
- Validation of results
- Product Development

Each review consists of 25 marks. Average of the marks scored in both the two reviews will be considered for final grading. The final certification and acceptance of TW ensures the satisfactory performance on the above aspects.

Table 3: Evaluation Table

Sr	Exam Seat No	Name of Student	Project Selection	Design/ Methodology	Fabrication/ Modeling/ Simulation	Result Verification	Presentation	Total
			5	5	5	5	5	25

Semester - VIII

Reinforcement Learning (PEAI8011T)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 10 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisite: Machine Learning, Machine Learning-II and Artificial Intelligence.

Course Objectives:

To make students learn to build programs that act in a stochastic environment, based on past experience using various Reinforcement Learning methods.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain basic and advanced Reinforcement Learning techniques.	L2	Understand
CO2	Identify suitable learning tasks to which Reinforcement learning and Deep Reinforcement Learning techniques can be applied.	L4	Analyze
CO3	Apply appropriate Reinforcement Learning method to solve a given problem.	L3	Apply
CO4	Integrate deep learning techniques with reinforcement learning, including the use of neural networks for function approximation and policy representation.	L6	Create

Course Contents

Unit-I — 04 Hrs.

Introduction: Reinforcement Learning (RL), Elements of Reinforcement Learning, Reinforcement Learning vs Supervised Learning, Approaches of solving Reinforcement Learning: Value based, policy based, model based, Exploration - Exploitation dilemma, Evolutionary methods, Immediate Reinforcement Learning.

Unit-II — 05 Hrs.

Immediate Reinforcement Learning:

Bandit Problems: Bandit problems, Value-action based methods (sample average), Greedy method, ϵ-greedy method, Incremental Implementation, Non-stationary problem, Optimistic Initial values, UCB algorithm, Thompson Sampling.

Policy Gradient Approaches: Linear reward Penalty Algorithm, Parameterised policy representation (Θ), Evaluation of policy ($\eta(\Theta)$), REINFORCE algorithm.

Unit-III — 06 Hrs.

Full Reinforcement Learning: Difference between Immediate and Full Reinforcement Learning, Agents and Environment,Goals, Rewards, Returns, Policy in Full Reinforcement Learning, Episodic and Continuing Tasks.

Markov Decision Process (MDP): Markov Property, Finite Markov Decision Process, Value functions, Bellman's equations, optimal value functions, Definition of MDP in Reinforcement Learning, Solution of the Recycling Robot problem

Unit-IV — 08 Hrs.

Dynamic Programing: Policy evaluation, policy improvement, policy iteration, value iteration, Asynchronous Dynamic Programing, Generalized Policy Iteration (GPI), bootstrap, full back up.

Monte Carlo Method: Advantages of Monte Carlo over Dynamic Programing, Monte Carlo Control, on-policy, off-policy, Incremental Monte Carlo, Issues/Assumptions in Monte Carlo Methods, Solution of BlackJack using Monte Carlo Method.

Unit-V — 08 Hrs.

Temporal Difference Learning: What is Temporal Difference learning, Advantages of Temporal Difference methods over Monte Carlo and Dynamic Programming methods, TD(0), On-policy vs off-policy, SARSA, Qlearning.

Eligibility traces: N-step Temporal Difference methods, On-line vs Off-line updation, TD(λ), forward view, backward view, Traces: Accumulating trace, Dutch trace, Replacing trace, Equivalence

forward and backward view, SARSA(λ).

Unit-VI 08 Hrs.

Deep Reinforcement Learning:

Function Approximation: Drawbacks of tabular implementation, Function Approximation, Gradient Descent Methods, Linear parameterization, Policy gradient with function approximation.

Deep Reinforcement Learning: Intro of Deep Learning in Reinforcement Learning, Deep learning training workflow, Categories of Deep learning, Deep Q-Network, Ways of improving Deep Q-Network, REINFORCE in Full Reinforcement Learning, Actor-Critic Algorithm, Algorithm Summary, DDPG, Case study on AlphaGo by Google DeepMind.

Text Books:

1. Richard S. Sutton and Andrew G. Barto, "Reinforcement Learning: An Introduction", MIT Press, 2nd Edition, 2018.
2. Laura Graesser Wah Loon Keng, "Foundations of Deep Reinforcement Learning", Pearson Education, 1st Edition, 2020.

Reference Books:

1. Phil Winder, "Reinforcement Learning Industrial Applications of Intelligent Agents", O'Reilly, 1st Edition, 2020.
2. Csaba Szepesvari, "Algorithms for Reinforcement Learning", Morgan & Claypool Publishers, 1st Edition, 2019.
3. Enes Bilgin, "Mastering Reinforcement Learning with Python", Packt publication, 1st Edition, 2020.
4. Brandon Brown, Alexander Zai, "Deep Reinforcement Learning in Action", Manning Publications, 1st Edition, 2020.
5. Micheal Lanham, "Hands-On Reinforcement Learning for Games", Packt Publishing, 1st Edition, 2020.
6. Abhishek Nandy, Manisha Biswas, "Reinforcement Learning: With Open AI, TensorFlow and Keras using Python", Apress, 1st Edition, 2018.

Weblinks:

1. NPTEL Course in Reinforcement Learning:
   https://onlinecourses.nptel.ac.in/noc22_cs75/preview
2. Reinforcement Learning Course (Stanford University):
   https://www.youtube.com/watch?v=FgzM3zpZ55o

3. AI Games with Deep Reinforcement Learning: https://towardsdatascience.com/how-to-teach-an-ai- to-play-games-deep-reinforcement-learning-28f9b920440a

4. Deep Reinforcement Learning: https://www.v7labs.com/blog/deep-reinforcement-learning-guide

Evaluation Scheme:

Theory :

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 10 marks each will be conducted during the semester.

2. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 65 marks.

2. Total duration allotted for writing the paper is 3 hrs.

Artificial Intelligence in Healthcare (PEAI8012T)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 10 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisite:

- Knowledge of Machine Learning (Supervised/Unsupervised Learning).
- Understanding of Deep Learning and Neural Networks.
- Familiarity with Data Science tools (Python, TensorFlow/PyTorch).

Course Objectives:

1. To understand the role of AI in transforming healthcare.
2. To learn how to apply AI techniques such as machine learning, deep learning, and natural language processing (NLP) to healthcare data.
3. To gain hands-on experience in working with real healthcare datasets.
4. To discuss ethical, privacy, and regulatory concerns related to AI in healthcare.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Classify the types of AI systems used in healthcare, including ML, natural language processing (NLP), and expert systems, and explain their role in healthcare transformation.	L2	Understand
CO2	Apply data mining techniques to healthcare datasets, EHRs, DICOM standards and exploratory data analysis (EDA) for medical imaging data.	L3	Apply
CO3	Explore AI applications in genomics, including various NGS pipelines, and evaluate how AI can predict genetic disorders and pandemics.	L4	Analyze
CO4	Evaluate AI's potential for discovering new drug candidates and streamlining clinical trial processes.	L5	Evaluate

Course Contents

Unit-I — 05 Hrs.

Introduction to AI in Healthcare:

Overview of AI in Healthcare: Historical perspective, Types of AI systems in healthcare, Role of AI in healthcare transformation.

Key Healthcare Domains for AI Applications: Medical imaging, Diagnostics, Drug discovery, Personalized medicine.

Challenges in Healthcare Data: Data variability, noise, and incompleteness, Data privacy and security concerns, Regulatory constraints.

Unit-II — 10 Hrs.

Data Mining and Agents for Healthcare: Introduction to Healthcare Data: Electronic Health Records (EHR), Medical imaging data (X-rays, MRIs, CT scans), Genomics and clinical trial data. Different 2D medical imaging modalities and their clinical applications, key stakeholders in the 2D medical imaging space, DICOM standards, DICOM dataset preparation, EDA Knowledge discovery and Data Mining, Evolutionary Algorithms, Illustrative Medical Application- Multiagent Infectious Disease Propagation and Outbreak Prediction, Automated Amblyopia Screening System etc.

Unit-III — 07 Hrs.

AI in Genomics and Disease Prediction:

Introduction to Molecular Biology, evolution of Bioinformatics – sequence alignment- indels, homology, identity, similarity, Orthology, paralogy and Xenology, Various NGS pipelines and tools, NCBI-genbank, Unitprot-Swissprot, KEGG, Genomics ad Pandemic Prediction.

Unit-IV — 07 Hrs.

AI-Driven Drug Discovery and Protenomics: Introduction to computational drug discovery and AI Case studies: AI in accelerating drug development.

AI for Personalized Medicine: AI-based genomic analysis, Predicting patient responses to therapies, Tailoring treatment plans using AI models.

Unit-V — 05 Hrs.

Emerging Trends of AI in Healthcare:

Wearable AI and Remote Monitoring: AI for patient monitoring using IoT and wearables.

AI in Robotics and Surgery: AI-assisted surgeries, robotic platforms and automation.

Telemedicine and AI Integration: AI-driven remote consultations and diagnostics.

Unit-VI 05 Hrs.

Privacy, and Regulations in Healthcare:

Ethical Considerations in AI for Healthcare: Bias in AI models and its implications, AI decision-making in healthcare.

Privacy and Security in Healthcare AI: Handling sensitive healthcare data, Regulations: HIPAA, GDPR, and their implications for AI.

Regulatory Aspects and AI Approval: AI in clinical trials and FDA approvals.

Text Books:

1. Hui Yang and Eva K. Lee, "Healthcare Analytics: From Data to Knowledge to Healthcare Improvement, Wiley Publication, 2016.
2. Adam Bohr and Kaveh Memarzadeh, "Artificial Intelligence in Healthcare", Science Direct, 2020.

Reference Books:

1. Topol E., "Deep Medicine: How Artificial Intelligence Can Make Healthcare Human Again", New York, NY: Basic Books, 2019.
2. Alejandro Frangi et al., "Medical Image Analysis", Elsevier, 2023.

Online Resources:

1. https://ai.stanford.edu/
2. https://drerictopol.com/tag/medical-ai/
3. https://medicalfuturist.com/
4. https://blogs.nvidia.com/blog/tag/healthcare-life-sciences/
5. https://www.coursera.org/specializations/ai-for-medicine/

Evaluation Scheme:

Theory :

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 10 marks each will be conducted during the semester.
2. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Quantum AI (PEAI8013T)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 10 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisite: Artificial Intelligence, Machine Learning

Course Objectives:

1. To get acquainted with the principles of quantum computing and the usage of Linear algebra in Quantum Computing.
2. To understand the Architecture of Quantum computing and solve examples of Quantum Fourier Transforms.
3. To study the Quantum Theory with Fault-Tolerant Quantum techniques.
4. To understand Problem-Solving using various peculiar search strategies for AI.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand quantum requirements and formulate design solutions using quantum circuits.	L2	Understand
CO2	Illustrate applicable solutions in one or more application domains using a quantum architecture that integrates ethical, social, and legal concerns.	L2	Understand
CO3	Apply the Advanced Quantum Algorithms on real time problem.	L3	Apply
CO4	Evaluate suitable algorithms for AI problems.	L5	Evaluate

Course Contents

Unit-I — 07 Hrs.

Overview of Quantum Computation: Single qubit gates, Multiple qubit gates, Measurements in bases Vs computational basis, Quantum circuits, Qubit copying circuit, Example: Bell states quantum teleportation.

Unit-II — 07 Hrs.

Quantum Architecture: The Framework of Quantum Mechanics: The State of a Quantum System, Time-Evolution of a Closed System, Composite Systems, Mixed States and General Operations, Universal Sets of Gates, Quantum measurement and entanglement, The quantum Fourier transform, Phase estimation, order-finding and factoring, General applications of the Fourier transform- Period-finding, Discrete logarithms

Unit-III — 07 Hrs.

Quantum Algorithms: Probabilistic Versus Quantum Algorithms, Phase Kick-Back, The Deutsch Algorithm, The Deutsch–Jozsa Algorithm, Simon's Algorithm, Shor's Algorithm, Factoring Integers, Grover's Algorithm.

Unit-IV — 07 Hrs.

Quantum Clustering and Data Analysis: Quantum Clustering Techniques, Quantum-enhanced K-means clustering using quantum annealing: Using quantum-inspired methods for data partitioning, Quantum walk-based clustering: applying quantum walks to explore data distributions. Applications of Quantum Clustering: Implementing quantum clustering algorithms on a quantum simulator, Comparing quantum clustering performance with classical clustering.

Unit-V — 07 Hrs.

Quantum Information Processing: Classical Error Correction: The Error Model Encoding, Error Recovery, The Classical Three-Bit Code, Fault Tolerance, Quantum Information: Quantum Teleportation, Quantum Dense Coding, Coding, Quantum Key Distribution, Distribution, Noise and error models in quantum systems, Quantum cryptography and secure communication.

Unit-VI — 04 Hrs.

Quantum AI applications: Quantum AI Application: Introduction to Pennylane : a cross -platform Python library, Quantum Neural Computation, Quantum Walk – Random insect.

Text Books:

1. Nielsen, M. & Chuang I., "Quantum Computation and Quantum Information", 2020.

2. "Lipton and Reagan's Quantum Algorithms via Linear Algebra: A Primer", 2014.

3. Kaye, LaFlamme and Mosca's, "Introduction to Quantum Computing", 2006.

4. Ray LaPierre, "Introduction to Quantum Computing", 2021.

5. Biamonte J. et al., "Quantum Machine Learning", Nature, 549(7671):195-202, 2017.

6. Andreas Wichert, "Principles Of Quantum Artificial Intelligence", 2013.

Reference Books:

1. Rieffel, E. G., & Polak, W. H., "Quantum computing: A gentle introduction", MIT Press, 2011.

2. Farhi, E., Goldstone, J., & Gutmann, S., "A quantum approximate optimization algorithm", arXiv preprint arXiv:1411.4028, 2014.

3. Kuttler, "Elementary Linear Algebra", 2012.

4. Kepner and Gilbert, "Graph Algorithms in the Language of Linear Algebra", 2011

5. Russell, S. & Norvig, P., "Artificial Intelligence: A modern approach", 4th Edition, Pearson Education, 2021.

E-Resources:

1. http://mmrc.amss.cas.cn/tlb/201702/W020170224608149940643.pdf

2. https://arxiv.org/pdf/1611.09347.pdf

3. http://mmrc.amss.cas.cn/tlb/201702/W020170224608150244118.pdf

4. https://www.researchgate.net/publication/282378154_FPGA-based_quantum_circuit_emulation

5. Microsoft Quantum Development Kit:
https://www.microsoft.com/enus/quantum/development-kit Forest

6. Learn quantum programming: https://pennylane.ai/qml/

7. Quantum machine learning: https://qiskit.org/learn/course/machine-learning-course/

8. Center for Excellence in Quantum Technology: https://research.ibm.com/blog/next-wave-quantum-centric-supercomputing

Web Links:

1. https://learn.qiskit.org/course/quantum-hardware/introduction-to-quantum-error-correction-using-the-repetition-code

2. https://quantumcomputinguk.org/tutorials/16-qubit-random-number-generator

3. https://quantumcomputinguk.org/tutorials/quantum-fourier-transform-in-qiskit

4. https://www.sciencedaily.com/releases/2021/02/210212094105.htm

5. https://www.medrxiv.org/content/10.1101/2020.11.07.20227306v1.full

Evaluation Scheme:

Theory :

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 10 marks each will be conducted during the semester.

2. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 65 marks.

2. Total duration allotted for writing the paper is 3 hrs.

Ethical AI (PEAI8021T)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 10 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisite: Artificial Intelligence, Machine Learning

Course Objectives:

1. To introduce the fundamental concepts of ethics in AI.
2. To explore the importance of transparency in AI systems, identifying practices that enhance stakeholder understanding and facilitate accountability.
3. To explore and analyze emerging themes in AI governance and policy, such as ethical considerations, workforce impacts, and regulatory challenges, and their implications for the future of AI globally.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand the principles of responsible AI development, including fairness, accountability, and transparency.	L2	Understand
CO2	Identify and describe various sources of bias in AI systems, including data collection, feature selection, and model training processes. Analyze real-world examples of bias in AI applications.	L2	Understand
CO3	Evaluate the role of fairness in AI governance. Identify strategies to promote equitable outcomes and mitigate biases in AI systems.	L5	Evaluate
CO4	Analyze the implications of privacy and anonymity for individuals and organizations in the context of data management and usage.	L4	Analyze

Course Contents

Unit-I — 05 Hrs.

Introduction: Artificial Intelligence Fundamentals, Need for ethics in AI. AI for Society and Humanity, ethics vs law/compliance, Responsible and interpretable AI,Principles for ethical practices, AI and social justice.

Unit-II — 08 Hrs.

Bias and Fairness: Sources of Biases, Techniques for detecting, mitigating, and preventing bias in data and models, limitation of a dataset, Preprocessing, inprocessing and postprocessing to remove bias, Fairness of classification algorithms: Handling Disparate Treatment/Disparate Impact, Fair Embeddings., Counterfactual fairness.

Unit-III — 08 Hrs.

Governance of AI: Role of government, academia, and industry in ethical AI development, Integrity, Transparency, Accountability, Fairness, Control, Sustainability, Democracy, Interoperability, Spread of hate content, Countering hate speech, The future of AI and its impact on humanity.

Unit-IV — 07 Hrs.

Transparency and Explainability in AI: Black-box AI vs. transparent AI. Explainability: methods and challenges, Explainability through causality, Model transparency, interpretability, and documentation in training processes, Model interpretability tools and frameworks (e.g., LIME, SHAP)

Unit-V — 05 Hrs.

Data ownership, privacy and anonymity: Understanding the difference between data ownership, data privacy and data anonymity, Idea behind surveillance, data privacy vs. data security, Security concerns in AI system, Differential privacy and federated learning in AI.

Unit-VI — 06 Hrs.

AI standards and regulation: National and international strategies on AI- Europe, North America, Asia, Africa, South America, Australia, International AI initiatives, Government Readiness for AI, Emerging Themes, Case studies: Healthcare robots.

Text Books:

1. Mark Coeckelbergh, "AI Ethics", The MIT Press Essential Knowledge series, 2020.
2. Evren Eryurek, Uri Gilad, Valliappa Lakshmanan, "Data Governance: The Definitive Guide - People, Processes, and Tools to Operationalize Data Trustworthiness", Shroff/O'Reilly, [illegible]

Edition, 2021.

3. Ian Foster, Rayid Ghani, Ron S. Jarmin, Frauke Kreuter, Julia Lane, "Big Data and Social Science: Data Science Methods and Tools for Research and Practic", Chapman and Hall/CRC, 2nd Edition, 2020.

4. AJ Kelly, "Ethics and Artificial Intelligence: A Comprehensive Guide", by Byte-Sized Press, January 2023.

5. Jonas Tallberg, Eva Erman, Markus Furendal, Johannes Geith, Mark Klamberg, Magnus Lundgren, "The Global Governance of Artificial Intelligence: Next Steps for Empirical and Normative Research", Oxford University Press (OUP), 2023.

6. Edited by Keith Frankish, "The Cambridge Handbook of Artificial Intelligence", The Open University, Las Vegas, 2014.

Reference Books:

1. Michael Negnevitsky, "Artificial Intelligence: A Guide to Intelligent Systems", 2001.

2. Markus Dubber, Frank Pasquale, Sunit Das, "OXFORD HANDBOOK OF ETHICS OF AI", 2021.

3. Michael Kearns and Aaron Roth, "The Ethical Algorithm: The Science of Socially Aware Algorithm Design", 2019.

4. Solon Barocas, Moritz Hardt, and Arvind Narayanan, "Fairness and Machine Learning: Limitations and Opportunities", 2023.

5. Christoph Stückelberger, Pavan Duggal, "Data Ethics: Building Trust: How Digital Technologies Can Serve Humanity", Globethics Publications, 1st Ediiton, 2023.

6. Gry Hasselbalch & Pernille Tranberg, "Data Ethics", PubliShare, 1st Edition, 2016.

7. Evren Eryurek, Uri Gilad, Valliappa Lakshmanan, "Data Governance: The Definitive Guide - People, Processes, and Tools to Operationalize Data Trustworthiness", Shroff/O'Reilly, 1st Edition, 2021.

Web links:

1. https://standards.ieee.org/initiatives/autonomous-intelligence-systems/
2. https://partnershiponai.org/
3. https://aiethicslab.com/
4. https://www.oxford-aiethics.ox.ac.uk/
5. https://www.media.mit.edu/groups/ethics-and-governance/overview/

Evaluation Scheme:

Theory :

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 10 marks each will be conducted during the semester.
2. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Image Generative AI (PEAI8022T)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 10 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisite: Deep Learning, Large Language Models

Course Objectives:

1. To provide students with a thorough grasp of image generative AI, including its historical context, key technologies, and applications across various industries.
2. To Equip students with hands-on experience in image generation techniques, manipulation, and evaluation methods.
3. Enable students to explore and analyze the diverse applications of image generative AI in fields such as art, healthcare, and entertainment.
4. Foster an understanding of the ethical considerations and societal impacts of image generation technologies, preparing students to address potential challenges and biases in the field.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand the principles of Image Generation and Implement Image Manipulation Techniques.	L2	Understand
CO2	Compare and contrast various generative models, including GANs and VAEs, and apply their architectures to real-world problems.	L4	Analyze
CO3	Demonstrate proficiency in using diffusion models and vision transformers in generating images and utilize vision language models to create and interpret text-image pairs, including text-to-image and image-to-text generation.	L3	Apply
CO4	Understand and apply techniques for video generation and critically assess the ethical implications of image generation.	L3	Apply

Course Contents

Unit-I — 05 Hrs.

Introduction and Applications of Image Generation: Overview of Image Generation, Historical Context and Evolution, Challenges, Types of Image Generation Techniques, Applications in Various Industries: Art and Design, Image-to-Image Translation, Super-Resolution, Face Generation, Deepfakes, 3D Image Generation.

Unit-II — 06 Hrs.

Image Manipulation and Representation: Introduction to Image Manipulation Techniques and overview of CNNs in Image Processing, Neural Style Transfer (NST), Encoding Images, image Representation techniques, Feature extraction methods, Latent Vector Representation, Evaluation Metrics for Generated Images : FID, PSNR, SSIM.

Unit-III — 08 Hrs.

VAEs and Variants of Generative Adversarial Networks: Architecture of GANs: Generator and Discriminator, Training GANs, Training dynamics and common pitfalls, Variants of GANs (e.g., DCGAN, StyleGAN), Introduction to Variational Autoencoders (VAEs), Advanced VAE Techniques: Variational inference and reparameterization trick. Conditional VAEs (CVAE) and Extensions.

Unit-IV — 08 Hrs.

Diffusion Models and Vision Transformers: Introduction to Diffusion Models, Concepts and architecture overview, Diffusion Probabilistic Models: Concept & Architecture (DALL-E, Stable Diffusion), Transformers in Image Generation, understanding transformer architecture, Hybrid models (e.g., VQ-VAE-2, LDM), Exploring combinations of different generative techniques.

Unit-V — 07 Hrs.

Vision Language Models and Image Generation: Introduction to Vision Language Models (VLMs), Understanding their purpose and functionality, Contrastive Language Image Pairs (CLIP), understanding CLIP Architecture and its applications, Text-to-Image Generation, Techniques and tools for generating images from text & Image-to-Text Generation, exploring methods for creating descriptions from images.

Unit-VI — 05 Hrs.

Video Generation & Ethical Considerations:

Video Generation: Video Generation Techniques, Popular Models and Applications.

Ethical Considerations: Ethical Implications of Image Generation Technologies, Addressing Bias,

in AI-generated Content, Future Trends in Image Generation Research and Application.

Text Books:

1. Denis Rothman, "Transformers for Natural Language Processing- Build innovative deep neural network architectures for NLP with Python, PyTorch, TensorFlow, BERT, RoBERTa, and more", 2nd Edition, Packt Publishing, 2023.
2. Zonunfeli Ralte, Indrajit Kar, "Learn Python Generative AI: Journey from autoencoders to transformers to large language models", 1st Edition 2024, ISBN: 978-93-55518-972.
3. Soon Yau Cheong, "Hands-On Image Generation with TensorFlow: A practical guide to generating images and videos using deep learning", Packt Publishing, 2020.
4. David Foster, "Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play", O'Reilly Media, Inc. June 2019, ISBN: 9781492041948.

Reference Books:

1. Martin Yanev, "Building AI Applications with OpenAI APIs: Leverage ChatGPT, Whisper, and DALL-E APIs to build 10 innovative AI projects", 2nd Edition, Packt Publishing, 2024.
2. Amita Kapoor, Antonio Gulli, Sujit Pal, "Deep Learning with TensorFlow and Keras – 3rd Edition: Build and deploy supervised, unsupervised, deep, and reinforcement learning models", 3rd Edition, Packt Publishing, 2022.
3. V Kishore Ayyadevara, Yeshwanth Reddy, "Modern Computer Vision with PyTorch: Explore deep learning concepts and implement over 50 real-world image applications", Packt Publishing, 2020.
4. Martinez, "TensorFlow 2.0 Computer Vision Cookbook: Implement machine learning solutions to overcome various computer vision challenges", 1st Edition, Packt Publishing, 2021.

Web links:

1. https://www.tensorflow.org/tutorials/generative/style_transfer
2. https://www.coursera.org/specializations/deep-learning
3. https://medium.com/@zhonghong9998/neural-style-transfer-creating-artistic-images-with-deep-learning-803409fc64c0
4. https://medium.com/@outerrencedl/a-simple-autoencoder-and-latent-space-visualization-with-pytorch-568e4cd2112a
5. https://pyimagesearch.com/2020/03/30/autoencoders-for-content-based-image-retrieval-with-keras-and-tensorflow/

6. https://realpython.com/generative-adversarial-networks/

7. https://towardsdatascience.com/reparameterization-trick-126062cfd3c3

8. https://shashank7-iitd.medium.com/understanding-vector-quantized-variational-autoencoders-vq-vae-323d710a888a

Evaluation Scheme:

Theory :

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 10 marks each will be conducted during the semester.
2. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Social Network Analysis (PEAI8023T)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 10 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisite: Probability and Statistics, Machine Learning

Course Objectives:

The analysis of massive networks which provide many computational, algorithmic, modeling challenges and research on the structure and analysis of such large networks.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Analyze a social network using various visualization tools.	L4	Analyze
CO2	Illustrate large-scale network data and mechanisms used for network growth models.	L3	Apply
CO3	Examine social networks analysis and prediction using case studies.	L5	Evaluate
CO4	Apply appropriate anomaly detection and graph representation method on a network.	L3	Apply

Course Contents

Unit-I — 06 Hrs.

Society & Network: Introduction, Use of social networks, defining a network, types of network (link-centric, node and link centric, local view, temporal view, generalization, real-world network), levels of social network analysis, graph visualization tools (web-based and standalone), applications.

Network Measures: Network basics, node centrality, assortativity, transitivity and reciprocity, similarity, degeneracy.

Unit-II — 07 Hrs.

Network Growth Models: Properties of real world networks, Random Network Model: Degree Distribution of Random Network, Binomial to Poisson Distribution, Evolution of a Random Network, Average Path Length, Clustering Coefficient, Random Network vs. Real-world Network, Ring Lattice Network Model, Watts-Strogatz Model: Network Formation, Preferential Attachment Model: Network Formation, Degree Dynamics, Limitations of BA Model.

Unit-III — 06 Hrs.

Link Analysis: Application of link analysis, Signed networks: Balance Theory of Undirected Signed Networks, Status Theory of Signed Networks, Triad Balance vs Status, Strong and Weak Ties: Strength of a Tie, Triadic Closure, Dunbar Number, Local Bridges and Importance of Weak Ties, PageRank, Personalised PageRank, DivRank, SimRank, PathSim.

Unit-IV — 08 Hrs.

Community Detection: Application of community detection, types of communities, community detection methods, Disjoint Community Detection: Node-centric community detection, modularity and community detection, Overlapping Community Detection: Clique Dynamics, Local Community Detection.

Link Prediction: Applications of link prediction, Evaluating Link Prediction methods, Heuristic models, Probabilistic models, Supervised Random Walk.

Unit-V — 05 Hrs.

Cascade Behaviours & Network Effects: Preliminaries and Important Terminologies, Cascade Models, Probabilistic Cascades, Epidemic Models, Independent Cascade Models, Cascade Prediction.

Unit-VI — 07 Hrs.

Anomaly Detection in Networks: Anomaly in Static Networks: Plain and attributed networks, relational learning, Anomaly in Dynamic Networks: Preliminaries, feature and decomposition based

approaches.

Graphical Representation Learning: Criterion of graph representation learning, pipeline, representation learning methods.

Text Books:

1. Tanmoy Chakraborty, "Social Network Analysis", 1st Edition, Wiley, 2021.
2. Stephen P Borgatti, Martin G. Everett, Jeffrey C. Johnson ,"Analyzing Social Networks", Sage Publications Ltd, 2nd Edition, 2018.

Reference Books:

1. Xiaoming Fu, Jar-Der Luo, Margarete Boos, "Social Network Analysis Interdisciplinary Approaches and Case Studies", 1st Edition, CRC Press, 2020.
2. Dr. Krishna Raj P.M., Mr. Ankith Mohan, Dr. Srinivasa K.G, "Practical Social Network Analysis with Python (Computer Communications and Networks)", 1st Edition, Springer, 2019.
3. John Scott, "Social Network Analysis", 4th Edition, SAGE Publications Ltd, 2017.
4. Song Yang, Franziska Barbara Keller, Lu Zheng, "Social Network Analysis: Methods and Examples", 1st Edition, SAGE Publications, 2016.

Web Links:

1. A course on Social Network Analysis: https://onlinecourses.nptel.ac.in/noc22_cs117/preview
2. A comprehensive guide to Social Network Analysis: https://towardsdatascience.com/how-to-get-started-with-social-network-analysis-6d527685d374
3. Social Network Analysis 101: Ultimate Guide Comprehensive Introduction for Beginners: https://visiblenetworklabs.com/guides/social-network-analysis-101/

Evaluation Scheme:

Theory :

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 10 marks each will be conducted during the semester.
2. Best of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Internship (INTAI8030L)

Practical Scheme
Practical : 20 Hrs./week
Credit : 10

Examination Scheme
Teacher Assessment : 150 Marks
End Sem Exam : 150 Marks
Total : 300 Marks

Course Objectives:

- To expose technical students for the industrial environment, allowing them to gain real-world experience and develop into competent professionals.
- To provide opportunities to learn and enhance the practical technical skills required for professional roles.
- To familiarize students with current technological developments relevant to their field of study.
- To develop technical writing skills for reports and projects.
- To introduce students to the responsibilities and ethics of the engineering profession.
- To develop an understanding of employee psychology, habits, attitudes, and problem-solving approaches.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Apply the basics of science and engineering to systematically investigate and interpret an engineering problem.	L3	Apply
CO2	Build technical knowledge to enhance the problem-solving approaches for complex problem.	L6	Create
CO3	Develop awareness about general workplace behavior and build interpersonal and team skills.	L6	Create
CO4	Develop logical reasoning, report writing, presentation and management skills.	L6	Create
CO5	Understanding of lifelong learning processes through internship experience.	L2	Understand

Internships offer valuable educational and career development opportunities by providing students with practical experience in their field of study. In Semester–VIII, students have two options for their internship: Industry Internship and In-house Internship.

1. Industry Internship

Industry Internship Guidelines:

- The Training and Placement (T&P) cell of the institute will arrange internships for students in industries/organizations after the seventh semester.
- Students are expected to accept internship offers regardless of the company, job profile, location, or stipend offered.
- Alternatively, students can individually apply by submitting "Student Internship Program Application" (available on Institute Website) for industry internships, adhering to the prescribed guidelines as follows:
    1. Only T&P department granted internship will be considered.
    2. The internship duration should be of minimum 12 Weeks.
    3. Each student needs to take prior permission from T&P department before proceeding for any internship opportunity on his/her own.
    4. Each student will be monitored twice (virtually/through online meetings) during the internship period in the presence of an industry mentor and the departmental faculty mentor and the concerned TPC.
    5. If any student wants to withdraw from the Internship, he/she can only be allowed within two weeks of joining the same. Such students will have to continue the semester VIII academic activities regularly along with In-house internship.

Expected Activity in Industry Internship:

- Students may choose to work on innovation or entrepreneurial activities resulting in start-ups or undergo internships with Industry/NGO/ Government organizations/Micro/ Small/ Medium enterprises to prepare for the industry.
- Every student is required to prepare a file containing documentary proofs of the activities done by him/her. The evaluation of these activities will be done twice (virtually/through online meetings) during the internship period by the committee constituted by the Head of the Department which shall include Industry mentor, faculty mentor and Department T&P Co-ordinator (TPC). The assessment criteria for continuous assessment is as per Table 4.
- The ESE will be jointly evaluated by an industry mentor, faculty member and department T&P coordinator (TPC). The evaluation criteria is as per Table 5.

Table 4: Continuous Assessment for Industry Internship

Internship Objectives and Goals (30 Marks)	Internship Experience Skills Gained/Enhanced (30 Marks)	Professional Development and Growth (30 Marks)	Internship Report (30 Marks)	Presentation (30 Marks)

Table 5: Evaluation Criteria of Industry Internship

Internship Objectives and Goals (30 Marks)	Internship Experience Skills Gained/Enhanced (30 Marks)	Professional Development and Growth (30 Marks)	Internship Report (30 Marks)	Presentation (30 Marks)

Industry Internship Report:

- Upon completion of the internship, students should prepare a comprehensive report that reflects their observations and learnings during the internship period. Students can consult their Industrial Supervisor, Faculty Mentor, or T&P Co-ordinator/Officer for guidance on selecting special topics and problems for the report.

- The internship report will be evaluated based on the following criteria:

  i. Adequacy and purposeful write-up.

  ii. Variety and relevance of learning experience.

  iii. Practical applications and connections with the fundamental theories and concepts covered in the course (Semester I to VII).

2. In-house Internship

The in-house internship provides students with research-oriented opportunities to cultivate a research mindset. It serves as an extension of the project completed in VI and VII semesters (Project Stage-I & II) or offers new objectives provided by the department or research guide.

1. The in-house internship can be pursued individually or as a group activity.
2. If extending a project from Stage II, at least one student in the group must have participated in Stage I & II.
3. If working on the topic offered by the department or in-house mentor, a group of fresh students can form a team.
4. The maximum group size is limited to four students.
5. In case of extension of project stage II, the outcomes should be in the form of product development/technology transfer along with patent and copyright / one research publication (UGC care listed journal/conference). Students can work jointly with any government

funding agency or industry. In such cases, a detailed project report shall be submitted after verification by the in-house mentor and industry/funding agency mentor/authority. In case of standalone/non-sponsored activity, i.e. without any funding agency/industry collaboration, the detailed project report shall be submitted after verification by the in-house mentor.

6. If pursuing a Topic offered by the department or in-house mentor, the outcome of the in-house internship should include the publication of a research paper, preferably in an SCI/Scopus/UGC care listed/indexed Journal/Conference. The detailed project report must be submitted and verified by the in-house mentor.

7. All the designated work shall be submitted to the department in the form of a report in hardbound as well as soft copy.

8. **Evaluation Scheme:**

   I. Continuous Assessment:

   (a) A logbook (as per Table 6) of the work done must be maintained by each group.

   (b) Each in-house internship activity will be reviewed twice in the semester. In the first review (as per Table 7), at least 40% work shall be completed including the topic identification / introduction/ scope of the work, literature survey, problem definition and objectives. The remaining 60% of work shall be completed in the second review (as per Table 8) including implementations, key findings, publications &/ patenting &/ copyright &/ product development etc.

   II. End Semester Examination:

   End semester examination (as per Table 9) will be jointly evaluated by the faculty mentor and an external examiner appointed by the HOD in consultation with the COE.

9. **Assessment Formats:**

Table 6: Log Book Format

Sr	Week (Start Date: End Date)	Work Done	Sign of In-house mentor	Sign of Coordinator
1				

Table 7: First Review

Topic Identification & Validation (20 Marks)	Literature Survey (20 Marks)	Problem Definition (20 Marks)	Objectives (15 Marks)

Table 8: Second Review

Implementation (20 Marks)	Publications (20 Marks)	Report (20 Marks)	Presentation (15 Marks)

Table 9: End Semester Examination

Topic Identification & Validation (30 Marks)	Literature Survey & Problem Definition (30 Marks)	Objectives & Implementation or Product Development (30 Marks)	Presentation (30 Marks)	Report, Publications/Patent/IPR Documents (30 Marks)