AUTONOMOUS

SYLLABUS

VII & VIII Semesters

B.E in Artificial Intelligence and Machine Learning

2023

MITE

Invent Solutions

MANGALORE INSTITUTE OF TECHNOLOGY & ENGINEERING

Institute Vision

*"To attain perfection in providing **Globally Competitive Quality Education** to all our Students and also benefit the global community by using our strength in **Research and Development**"*

Institute Mission

*"To establish world class educational institutions in their respective domains, which shall be C**enters of Excellence** in their stated and implied sense. To achieve this objective we dedicate ourselves to meet the challenges of becoming **Visionary and Realistic**, **Sensitive and Demanding**, **Innovative and Practical,** Theoretical **and Pragmatic;** ALL at the same time"*

Department Vision

"To create well groomed, technically competent and skilled AIML professionals who can become part of industry and undertake quality research at global level to meet societal needs."

Department Mission

- *Provide state of art infrastructure, tools and facilities to make students competent and achieve excellence in education and research.*
- *Provide a strong theoretical and practical knowledge across the AIML discipline with an emphasis on AI based research and software development.*
- *Inculcate strong ethical values, professional behaviour and leadership abilities through various curricular, co-curricular training and development activities.*

Program Educational Objectives (PEOs)

- *Graduates will follow logical, practical and research-oriented approach for solving the real world problems by providing AI based solutions.*
- *Graduates will work independently as well as in multidisciplinary teams at workplace.*
- *Graduates will setup start-up and become successful entrepreneurs.*

Program Specific Outcomes (PSOs)

The graduates of AIML department will be able to

- *Train machine learning models to address real life challenging problems using acquired AI knowledge.*
- *Develop applications using ML techniques related to the field of medical, agriculture, defence, education and various scientific explorations.*

LIST OF COURSES

VII / VIII Semester Courses			
Sl. No.	**Course Code**	**Course Title**	**Semester**
		PROFESSIONAL CORE COURSES	
1	**23AIPC401**	Natural Language Processing	VII
2	**23AIPC402**	Deep Learning	VII
		PROFESSIONAL ELECTIVE COURSES	
3	**23AIPE411**	Cloud Computing	VII
4	**23AIPE412**	Prompt Engineering for AI Agents	VII
5	**23AIPE413**	Nature Inspired Computing	VII
6	**23AIPE42X**	MOOCs (NPTEL/SWAYAM)	VIII
		OPEN ELECTIVE COURSES	
7	**23AIOE411**	IoT for Automation	VII
8	**23AIOE412**	Data Visualization and Analytics	VII
9	**23AIOE413**	Software Testing	VII
		SKILL ENHANCEMENT COURSES	
10	**23AISE409**	Project Phase -II	VII
11	**23AISE431**	Internship	VIII
12	**23AISE432**	Publication / Patenting	VIII
		HUMANITIES & SOCIAL SCIENCE COURSE	
13	**23HMCC421**	Constitution of India & Professional Ethics	VII

MANGALORE INSTITUTE OF TECHNOLOGY & ENGINEERING

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VII Semester (2023 Scheme): Artificial Intelligence & Machine Learning

Sl. No	Course Code	Course Title	Category	Teaching Dept.	Teaching Hours /Week			Examination Marks			Duration of Exam in Hrs	Credits
					L	T	P	CIE	SEE	Total		
1	23AIPC401	Natural Language Processing	Professional Core Course	AIML	3	0	2	50	50	100	3	4
2	23AIPC402	Deep Learning	Professional Core Course	AIML	3	0	2	50	50	100	3	4
3	23AIPE41X	Professional Elective –III *	Discipline Specific Elective	AIML	3	0	0	50	50	100	3	3
4	23AIOE41X	Open Elective – III **	Open Electives	AIML	3	0	0	50	50	100	3	3
5	23AISE409	Project Phase-II	Skill Enhancement	AIML	-	-	12	100	100	200	-	6
7	23HMCC421	Constitution of India & Professional Ethics	Humanities & Social Sciences	Humanities/ Any Department	1	0	0	100	-	100	-	1
											Total Credits	**21**

***Professional Elective Course –III :**

Sl. No.	Course Code	Course Title
1	23AIPE411	Cloud Computing
2	23AIPE412	Prompt Engineering for AI Agents
3	23AIPE413	Nature Inspired Computing

****Open Elective Course-III :**

Sl. No.	Course Code	Course Title
1	23AIOE411	IoT for Automation
2	23AIOE412	Data Visualization & Analytics
3	23AIOE413	Software Testing

VIII Semester (2023 Scheme): Artificial Intelligence & Machine Learning

Sl. No	Course Code	Course Title	Category	Teaching Dept.	Teaching Hours /Week			Examination Marks			Duration of Exam in Hrs	Credits
					L	T	P	CIE	SEE	Total		
1	23AIPE42X	MOOCs * (NPTEL/SWAYAM) 8/12 WEEKS *	Professional Elective	AIML	-	-	-	-	-	100	-	2
2	23AISE431	Internship	Skill Enhancement	AIML	-			100	100	200	3	12
3	23AISE432	Publication / Patenting	Skill Enhancement	AIML	-	-	-	100	-	100	-	2
											Total Credits	**16**

* **Massive Open Online Courses (MOOCs) -** Identified by the BoS of the department

<u>Guidelines for MOOCs</u>

To promote self-paced, flexible, and industry-relevant learning, a Two-Credit Online professional elective course is introduced in the VIII semester curriculum for all Bachelor of Engineering (B.E.) programs. Students are required to complete an approved online course as per the following guidelines:

1. **Registration and Course Completion:**

   Students must complete any one of the *Board of Studies (BOS)* approved online courses by registering for an 8-week or 12-week course offered through recognized platforms such as NPTEL or SWAYAM. Registration can be done during semester VI or semester VII.

2. **Credit Conversion:**

   The score obtained in the proctored examination conducted by the respective online platform shall be formally converted into course credits as per institute norms.

3. **Provision for students failing to clear the Online Course**

   If a student fails to successfully complete the selected online course within two consecutive attempts before the commencement of Semester VIII, they must register for an elective course offered by the respective department. This elective will be delivered in online mode by the department.

4. **Assessment Pattern for the alternate elective:**

   a. All assignments for the alternate elective course must be submitted online.
   b. The Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE) shall be conducted in offline mode.
   c. Students must physically appear for these examinations at the institute.

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VII & VIII Semester

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1.	**23AIPC401**	Natural Language Processing	1-4
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4.	**23AIPE412**	Prompt Engineering for AI Agents	10-11
5.	**23AIPE413**	Nature Inspired Computing	12-13
6.	**23AIOE411**	IoT for Automation	14-15
7.	**23AIOE412**	Data Visualization and Analytics	16-17
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9.	**23AISE409**	Project Phase - II	20-22
10.	**23AISE431**	Internship	23-26
11.	**23AISE432**	Publication/Patenting	27-29
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Natural Language Processing			
Semester	**VII**	CIE Marks	**50**
Course Code	**23AIPC401**	SEE Marks	**50**
Teaching Hours/Week (L:T: P)	**3:0:2**	Exam Hrs	**3**
Total Hours	**40+24**	Credits	**4**

Course Learning Objectives: This course is designed to

1. **Impart** knowledge on linguistic structure, tokenization techniques, corpora, and text similarity measures.
2. **Provide** knowledge on statistical approaches to language modeling using N-gram models, smoothing, perplexity, and text generation.
3. **Familiarize** semantic representations such as embeddings and neural network architectures used for NLP tasks.
4. **Provide knowledge on** modern Large Language Models and Transformer architectures, including prompting, generation, training principles, and ethical considerations

Module 1: Introduction	**No. of Hrs: 8+6**

Introduction, Language and Knowledge, Challenges of NLP, Language and Grammar,NLP Applications, Words and Tokens: Words, Morphemes: Parts of Words, Unicode, Subword Tokenization: Byte-Pair Encoding, Rule-based tokenization, Regular Expressions, Minimum Edit Distance.

Laboratory Experiments :

1. Write a Python program to perform following tasks
   a. Read a text corpus.
   b. Perform word tokenization and sentence tokenization.
   c. Apply Byte Pair Encoding (BPE) for subword tokenization.
   d. Display the generated subword vocabulary.
2. Write a python program to perform following tasks
   a. Uses regular expressions to extract Email IDs, URLs, Dates from text.
   b. Implement Minimum Edit Distance algorithm to compute distance between two words.
   c. Display edit operations (insert, delete, substitute).

Text Book 1: Chapter 1.1,1.3 ,1.4,1.5,1.7
Text Book 2: Chapter 2:2.1-2.5,2.7,2.9

Module 2 N-gram Language Models	**No. of Hrs: 8+4**

N-Grams, Evaluating Language Models: Training and Test Sets, Evaluating Language Models: Perplexity, Sampling sentences from a language model, Smoothing, Interpolation, and Backoff.

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Laboratory Experiments :

1. Write a python program to perform following tasks
    a. Preprocess a text corpus.
    b. Generate unigram and bigram counts.
    c. Compute probability of next word using bigram model.
2. Write a python program to perform following tasks
    a. Train an N-gram language model.
    b. Split the dataset into training and test sets.
    c. Compute perplexity of the test dataset.

Text book 2: Chapter 3:3.1 to 3.4,3.6

Module 3 Embeddings &Classification	**No. of Hrs: 8+6**

Embedding: Lexical Semantics, Vector Semantics, Simple count-based embeddings, Cosine for measuring similarity, Word2vec, Evaluating Vector Models. Feedforward networks for NLP: Classification, Embeddings as the input to neural net classifiers, Training Neural Nets.

Laboratory Experiments :

1. Write a python program to perform following tasks:
    a. Load pretrained Word2Vec or GloVe embeddings.
    b. Accept two words from the user.
    c. Compute cosine similarity.
    d. Display top 5 similar words.
2. Write a python program to perform following tasks:
    a. Convert text dataset into embeddings.
    b. Train a feedforward neural network classifier.
    c. Classify documents into categories.
    d. Evaluate using accuracy and confusion matrix.

Text Book 2: Chapter 5:5.1 to 5.5,5.9 Chapter 6:6.3-6.6

Module 4 :Large Language Models	**No. of Hrs: 8+4**

Large Language Models, Three architectures for language models, Conditional Generation of Text: The Intuition, Prompting, Generation and Sampling, Training Large Language Models, Evaluating Large Language Models.

Laboratory Experiments :

1. Develop a Python program using HuggingFace Transformers to:
    a. Load a pretrained GPT-based model.
    b. Accept a prompt from user.
    c. Generate text continuation.
    d. Compare outputs using different sampling methods.
2. Write a program to:
    a. Generate multiple responses using an LLM.
    b. Compute evaluation metrics such as:
        i. Perplexity
        ii. BLEU score
    c. Compare outputs generated using different prompts.

Text Book 2: Chapter 7:7.1 to 7.6

Module 5 :Transformers	**No. of Hrs: 8+4**

Transformers: Attention, Transformer Blocks, Parallelizing computation using a single matrix X, The input: embeddings for token and position, The Language Modeling Head, More on Sampling, Training, Dealing with Scale, Interpreting the Transformer.

Laboratory Experiments :

1. Develop a python program to:
    a. Load a pretrained BERT model.
    b. Input a sentence.
    c. Extract and visualize attention weights.
    d. Interpret token relationships.
2. Write a Python program to:
    a. Load pretrained BERT Question Answering model.
    b. Provide a context paragraph.
    c. Accept user question.
    d. Extract answer from context.

Text Book 2: Chapter 8

Course Outcomes: At the end of the course, the student will be able to

1.Describe language structure, tokenization, subword models, edit distance, and basic statistical language models.

2.Compute probabilistic and vector-based representations, including N-grams, embeddings, similarity measures, and evaluation metrics.

3.Illustrate word embeddings and neural network classifiers, including Word2Vec, cosine similarity, and feedforward networks.

4.Explain Large Language Models and Transformer architectures, including model principles, architecture, text generation workflows, training, and evaluation.

5.Apply Large Language Models and Transformers to perform text generation, sequence modeling, embeddings, sampling, and evaluation tasks.

Textbooks: 1. Tanveer Siddiqui, U.S. Tiwary, "Natural Language Processing and Information Retrieval", Oxford University Press. 2008 2. Dan Jurafsky and James H. Martin, "Speech and Language Processing", 2024
Reference Books: 1. Akshay Kulkarni, Adarsha Shivananda, "Natural Language Processing Recipes - Unlocking Text Data with Machine Learning and Deep Learning using Python", Apress, 2019. 2. T V Geetha, "Understanding Natural Language Processing – Machine Learning and Deep Learning Perspectives", Pearson, 2024. 3. Gerald J. Kowalski and Mark.T. Maybury, "Information Storage and Retrieval systems", Kluwer Academic Publishers.
Web link 1. NLP basics and applications: https://www.youtube.com/watch?v=M7SWr5xObkA 2. Core NLP techniques : https://youtu.be/02QWRAhGc7g 3. NLP practical concepts: https://www.youtube.com/watch?v=CMrHM8a3hqw 4. NPTEL NLP course : https://onlinecourses.nptel.ac.in/noc23_cs45/preview 5. NPTEL NLP course : https://archive.nptel.ac.in/courses/106/106/106106211/

Deep Learning			
Semester	**VII**	CIE Marks	**50**
Course Code	**23AIPC402**	SEE Marks	**50**
Teaching Hours/Week (L:T: P)	**3:0:2**	Exam Hrs	**3**
Total Hours	**40+24**	Credits	**4**

Course Learning Objectives: This course is designed to

1. **Familiarize** with the conceptual and mathematical foundations of linear neural networks, multilayer perceptrons, and deep neural network models.
2. **Impart** the knowledge and skills required to design and implement modern deep learning architectures.
3. **Provide** practical exposure to applying deep learning techniques in advanced computer vision tasks such as image classification, object detection, and semantic segmentation.
4. **Impart** knowledge on building, training, and evaluating deep learning and generative models using appropriate optimization techniques.

Module 1: Linear & MultiLayer Neural Networks	**No. of Hrs: 8+6**

Linear Neural Network : Softmax Regression based classification, Classification Dataset, Implementation of Softmax Regression from Scratch, Implementation of Softmax Regression using High Level APIs, **Multilayer Neural Network:** Implementation of Multilayer Perceptrons from Scratch, Implementation of Multilayer Perceptrons using High Level APIs, Weight Decay, Dropout, Numerical Stability and Initialization, Environment and distribution shift.

Lab Experiments :

1. Implement Linear Neural Network based Classification using softmax regression for any example dataset and Analyze the performance of the model by adjusting various hyperparameters.
2. Implement Multilayer Neural Network based Classification using softmax regression for any example dataset and Analyze the performance of the model by adjusting various hyperparameters.

Text Book 1: Chapter 2.1,2.3, 3.4.1, 3.4.2, 3.4.3, 3.4.4, 3.4.5, 3.4.7, 3.5, 3.6, 3.7, 4.2, 4.3, 4.5, 4.6, 4.8, 4.9.

Module 2: Modern Convolution Neural Network Architectures	**No. of Hrs: 8+4**

Deep Learning Computation : Layers and Block, Parameter Management, Deferred Initialization, Custom Layers, File I/O, GPU, **Deep Convolutional Neural Networks :** Alex Net, Networks Using Blocks(VGG), Network in Network (NiN), Networks with Parallel Concatenations (GoogLeNet), Batch Normalization, Residual Networks (ResNet), Densely Connected Networks (DenseNet).

Lab Experiments :

1. Comparative Analysis of AlexaNet, VGG, and GoogLeNet Architectures for Image Classification.
2. Comparative Analysis of ResNet and DenseNet Architectures for Image Classification.

Text Book 1:Chapter 5.1 to 5.6, 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7.

Module 3: Recurrent Neural Networks	**No. of Hrs: 8+4**

Sequence Models, Recurrent Neural Networks, Gated Recurrent Units (GRU), Long Short-Term Memory (LSTM), Deep Recurrent neural networks, Bidirectional Recurrent neural networks, Encoder-Decoder Architecture, Sequence to Sequence, Attention, Sequence to Sequence Attention

Lab Experiments :

1. Implement and compare RNN, LSTM, and GRU models for a sequence learning task, and analyze their training and inference computational cost.

Text Book 1: Chapter 8.1, 8.4, 9.1, 9.2, 9.3, 9.4, 9.6, 9.7, 10.1, 10.2

Module 4 : Optimization Algorithms & GAN	**No. of Hrs: 8+4**

Optimization Algorithms : Optimization in Deep Learning, Momentum, Adagrad, RMStop, Adadelta, Adam, **Generative Adversarial Networks :** Overview, Deep Convolutional Generative Adversarial Networks.

Lab Experiments :

1. Implement Adagrad, RMSProp, and Adadelta optimization algorithms on a neural network model and analyze their convergence behavior during training.
2. Implement Generative Adversarial Networks (GANs) for example dataset and Analyze the performance of the model using hyperparameter adjustments.

Text Book 1: Chapter 11.1, 11.6 to 11.10, 17.1, 17.2

Module 5: Deep Learning Models for Computer Vision	**No. of Hrs: 8+6**

Image Augmentation, Fine-Tuning, Object Detection and Bounding Boxes, Anchor Boxes, Multiscale Object Detection, The Object Detection Dataset, Single Shot Multi box Detection (SSD), Region-based CNNs(R-CNNs), Semantic Segmentation, Dataset, Transposed Convolution, FCN for Semantic Segmentation, Neural Style Transfer.

Lab Experiments :

1. Implement Object Detection for example dataset using SSD & Analyze the performance of the model using hyperparameter adjustments.
2. Implement Semantic Segmentation for example dataset using FCN and Analyze the performance of the model using hyperparameter adjustments.

Text Book 1: Chapter 13.1 to 13.12

Course Outcomes : At the end of the course, the student will be able to

1. **Illustrate** the fundamental concepts and architectures of linear, multilayer, convolutional, and used in deep learning.
2. **Describe** the learning paradigms of sequence models, recurrent neural networks and generative models for representation learning and performance optimization.
3. **Explain** deep learning architectures for advanced computer vision tasks including image classification, object detection, and semantic segmentation.
4. **Apply** linear, multilayer, deep convolution architecture and sequence-based recurrent neural network models using effective optimization techniques for real-world applications.
5. **Apply** various deep learning techniques for object detection, semantic segmentation & style transfer based compute vision applications.

Textbooks:

1. Aston Zhang, Zachary C. Lipton, Mu Li and Alexander J.Smola "Dive Into Deep Learning", 2020

Reference Books:

1. Simon J.D. Prince, "Understanding Deep Learning", MIT Press, 2023.
2. Rowel Atienza, "Advanced Deep Learning with TensorFlow 2 and Keras", 2nd Edition, PACT Publisher, 2020.

Web link

1. Interactive deep learning book with code, math, and discussions: https://d2l.ai/
2.Understanding Deep Learning Video Lectures : https://udlbook.github.io/udlbook/

Cloud Computing			
Semester	**VII**	CIE Marks	**50**
Course Code	**23AIPE411**	SEE Marks	**50**
Teaching Hours/Week (L:T: P)	**3:0:0**	Exam Hrs	**3**
Total Hours	**42**	Credits	**3**

Course Learning Objectives: This course is designed to

1. **Provide** knowledge on working of distributed system models, scalable Internet computing, and cloud systems.
2. **Familiarize** virtualization concepts and its application in data center automation.
3. **Provide** insights on various cloud computing architecture and service models.
4. **Impart** knowledge on cloud security concepts and cloud programming environments,

Module 1:Distributed System Foundations	**No. of Hrs: 8**

Distributed System Models and Enabling Technologies: Scalable Computing Over the Internet, Technologies for Network Based Systems, System Models for Distributed and Cloud Computing, Software Environments for Distributed Systems and Clouds, Performance, Security and Energy Efficiency.

Textbook 1: Chapter 1: 1.1 to 1.5

Module 2: Virtualization	**No. of Hrs: 8**

Virtual Machines and Virtualization of Clusters and Data Centers: Implementation Levels of Virtualization, Virtualization Structure/Tools and Mechanisms, Virtualization of CPU/Memory and I/O devices, Virtual Clusters and Resource Management, Virtualization for Data Center Automation.

Textbook 1: Chapter 3: 3.1 to 3.5

Module 3: Cloud Platform Architecture	**No. of Hrs: 9**

Cloud Platform Architecture over Virtualized Datacenters: Cloud Computing and Service Models, Data Center Design and Interconnection Networks, Architectural Design ofCompute and Storage Clouds, Public Cloud Platforms: GAE, AWS and Azure, Inter-Cloud Resource Management.

Textbook 1: Chapter 4: 4.1 to 4.5

Module4:Cloud Security	**No. of Hrs: 8**

Cloud Security: Top concern for cloud users, Risks, Privacy Impact Assessment, Cloud Data Encryption, Security of Database Services, OS security, VM Security, Security Risks Posed by Shared Images and Management OS, XOAR, A Trusted Hypervisor, Mobile Devices and Cloud Security.

Textbook 2: Chapter 11: 11.1 to 11.3, 11.5 to 11.8, 11.10 to 11.14

Module 5:Cloud Programming and Software Environments	**No. of Hrs: 9**

Cloud Programming and Software Environments: Features of Cloud and Grid Platforms, Parallel and Distributed Computing Paradigms, Programming Support for Google App Engine, Programming on Amazon AWS and Microsoft, Emerging Cloud Software Environments.

Textbook 1: Chapter 6: 6.1 to 6.5

Course Outcomes: At the end of the course, the student will be able to

1. **Explain** distributed system models, enabling technologies, virtualization concepts, and cloud computing architectures.
2. **Apply** virtualization techniques for CPU, memory, and I/O devices to design and manage virtual clusters and data center resources.
3. **Describe** cloud security mechanisms and risk assessment strategies in cloud environments.
4. **Illustrate** the process of building cloud-based applications using appropriate programming models and tools in cloud computing environments.

Textbooks:

1. Kai Hwang, Geoffrey C. Fox, and Jack J. Dongarra, Distributed and Cloud Computing, Morgan Kaufmann, Elsevier, 2012.
2. Dan C. Marinescu, "Cloud Computing Theory and Practice", Morgan Kaufmann, Elsevier, 2013

Reference Books:

1. RajkumarBuyya, Christian Vecchiola, and ThamraiSelvi, Mastering Cloud Computing, McGraw Hill Education, 2013.
2. Toby Velte, Anthony Velte, Cloud Computing: A Practical Approach, McGraw-Hill Osborne Media, 2010.
3. APA: Dotson, C. (2024). Practical Cloud Security: A Guide for Secure Design and Deployment (2nd ed.). O'Reilly Media

Web links:

1. NPTEL Course : https://nptel.ac.in/courses/106105167
2. Google Cloud Computing Foundations Certificate : https://www.skills.google/paths/36

Prompt Engineering for AI Agents			
Semester	**VII**	CIE Marks	**50**
Course Code	**23AIPE412**	SEE Marks	**50**
Teaching Hours/Week (L:T: P)	**3:0:0**	Exam Hrs	**3**
Total Hours	**42**	Credits	**3**

Course Learning Objectives: This course is designed to

1. **Impart** knowledge of the fundamentals of Large Language Models (LLMs), their evolution, architecture, and the role of prompt engineering in natural language processing.
2. **Provide** understanding of how LLMs process text, including tokenization, auto-regressive generation, handling hallucinations, probabilities in text generation, and context management.
3. **Familiarize** with prompt engineering techniques, including static and dynamic content, few-shot prompting, retrieval-augmented generation, and structured conversation strategies for practical applications.
4. **Introduce** concepts of LLM workflows, chat-based application design, tool integration, and interaction loop management for building real-world conversational agents.

Module 1: Introduction	**No. of Hrs: 09**

Introduction: Overview, Early Language Models, GPT Versions, Prompt Engineering.

Understanding LLMs: Promt Based Document Completion, Human Thought versus LLM Processing, Hallucinations, World Representation in LLMs, Deterministic Tokenization Mechanism, Constraints in Letter-Level Text Processing, Text Interpretation Differences in LLMs, Counting Tokens, Auto-Regressive Models, Temperature Hyperparameter and Probabilities, Transformer Architecture.

Text Book 1: Chapter 1, Chapter 2

Module 2: Chat-Based LLM Applications	**No. of Hrs: 08**

Reinforcement Learning from Human Feedback, Process of Building an RLHF Model, Transition from Instruct to Chat Models, Chat Models, Prompt Engineering as Playwriting.

Designing LLM Applications: Anatomy of LLM Application: User Input, Converting Input to Model Domain, LLM Prompt Query, Prompt Response, Feedforward Pass.

Text Book 1: Chapter 3, Chapter 4

Module 3: Prompt Content and Assembly	**No. of Hrs: 08**

Prompt Content: Sources of prompt content, static content, few-shot prompting, dynamic content, dynamic context identification, retrieval-augmented generation, and summarization.

Assembling the Prompt: Anatomy of an ideal prompt, advice conversations, analytic reports, structured documents, formatting snippets and few-shot examples, Relationships among Prompt Elements.

Text Book 1: Chapters 5 , Chapter 6

Module 4: Taming LLMs and Conversational Agents	No. of Hrs: 08
Taming the Model: Anatomy of LLM completion, preamble, recognizable start and end, postscript, log probabilities, evaluating completion quality, LLMs for classification, critical points in prompt design, model selection. **Conversational Agency:** LLMs trained for tool usage, guidelines for tool definitions, reasoning and chain-of-thought methods, ReAct and iterative reasoning, context for task-based interactions, sources of context, selecting and organizing context, building a conversational agent, managing conversations, user experience. **Text Book 1:** Chapters 7, Chapter 8	
Module 5: LLM Workflows for Complex Agents & Evaluation	**No. of Hrs: 09**
LLM Workflows: basic LLM workflows, task identification, assembling workflows, example workflow (Shopify plug-in marketing), advanced LLM workflows, LLM agents driving workflows, stateful task agents, roles and delegation. **Evaluating LLM Applications:** Evaluation objectives, offline evaluation, example suites, sample selection, solution evaluation, SOMA assessment, online evaluation, A/B testing, metrics for performance assessment. **Text Book 1:** Chapters 9, Chapter 10	
Course Outcomes: At the end of the course, the student will be able to 1. **Explain** the fundamentals of prompt engineering & LLMs process to generate text in chat-based applications 2. **Describe** the transition to chat models, components of LLM applications, prompt content types, and prompt assembly techniques. 3. **Apply** prompt engineering techniques such as few-shot prompting, retrieval-augmented generation, and dynamic context handling to design effective LLM-based solutions 4. **Explain** techniques for controlling LLM outputs, designing conversational agents, and evaluating LLM-based systems. 5. **Illustrate** LLM workflows, conversational agents, and evaluation strategies for task-oriented applications	
Textbooks: **1.** John Berryman, Albert Ziegler, "Prompt Engineering for LLMs: The Art and Science of Building Large Language Model-Based Applications", 1st Edition, O'Reilly Media, 2025	
Reference Books: 1. Anand Nayyar, Ajantha Devi Vairamani, Kuldeep Kaswan, "Mastering Prompt Engineering: Deep Insights for Optimizing Large Language Models (LLMs)", 1st Edition, Morgan Kaufmann (Elsevier), 2025. 2. Navveen Balani, "Prompt Engineering: Unlocking Generative AI: Ethical Creative AI for All", 1st Edition, 2023	
Web link 1. NPTEL Course on LLM : https://onlinecourses.nptel.ac.in/noc25_cs45/preview 2. Online Tutorial website : https://www.promptingguide.ai/	

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NATURE INSPIRED COMPUTING			
Semester	**VII**	CIE Marks	**50**
Course Code	**23AIPE413**	SEE Marks	**50**
Teaching Hours/Week (L:T: P)	**3:0:0**	Exam Hrs	**3**
Total Hours	**42**	Credits	**3**

Course Learning Objectives: This course is designed to

1. **Familiarize** the optimization problems and the limitations of classical methods.
2. **Provide** an in-depth understanding of evolutionary and swarm intelligence-based meta heuristics approaches.
3. **Impart** the knowledge on various applications of nature-inspired algorithms to solve complex engineering problems.

Module 1: Introduction to Optimization and Classical Methods	**No. of Hrs: 08**

Introduction and Fundamentals of Optimization, Types of Optimization Problems, Examples of Optimization, Formulation of Optimization Problem, Classification of Optimization Algorithms. Classical Optimization Methods: Introduction and Mathematical Model of Optimization.

Textbook 1: Chapters 1.2-1.6, 2.2

Module 2: Evolutionary Algorithms	**No. of Hrs: 08**

Genetic Algorithm: Basics of Genetic Algorithm, Genetic Operators, Schema Theory, and Prisoner's Dilemma Problem. Genetic Programming (GP): Basics of Genetic Programming, Data Structures for Genetic Programming, Binary Tree Traversals, and GP Operators. Genetic Programming Algorithm and Pseudocode,Variants of the GP Algorithm

Textbook 1: Chapters 4.2, 4.3, 4.7, 4.8, 5.2-5.8

Module 3: Classical Swarm Intelligence Algorithms	**No. of Hrs: 08**

Particle Swarm Optimization: Swarm Behavior, Particle Swarm Optimization Algorithm. Differential Evolution: Mutation and Crossover mechanisms, and Variants of the DE Algorithm. Ant Colony Optimization: Ant Colony Characteristics, and application to the Traveling Salesman Problem. Bee Colony Optimization: Honey Bee Foraging Behavior, Bee Colony Optimization Algorithm and Pseudocode.

Textbook 1: Chapters 6.2-6.3, 7.2-7.3, 8.2, 8.3.1, 9.2-9.3

Module 4: Advanced Swarm Intelligence Algorithms	**No. of Hrs: 09**

Fish School Search : Fish School Behavior, Fish School Search Optimization. Cuckoo Search : Cuckoo Bird Behavior, and the integration of Levy Flights, Cuckoo Search Optimization. Firefly Algorithm: Firefly Behavior and Characteristics, Firefly-Inspired Optimization. Bat Algorithm: Behavior of Bats in Nature, Bat Optimization Algorithm

Text Book 1: Chapters 10.2-10.3, 11.2-11.4, 12.2-12.3, 13.2

Module 5: Advanced Swarm Heuristics and Applications	**No. of Hrs: 09**

Biological Pollination and Social Hierarchy: Flower Pollination Optimization, Gray Wolf Characteristics, and Gray Wolf Optimization Emerging Metaheuristics: Elephant Herding Optimization, Crow Search Algorithm, and Raven Roosting Optimization Algorithm. Implementation and Benchmarking: Benchmark Test Functions and Real-world Applications in Network Routing, Job Scheduling problem, and Feature Reduction problem. **Text Book 1: Chapters 14.2-14.3, 15.2-15.3, 16.2-16.3, 17.3, 18.2-18.3, 19.**
Course Outcomes: At the end of the course, the student will be able to 1. **Explain** the transition from classical deterministic optimization methods to stochastic nature-inspired paradigms. 2. **Explain** the principles of intelligence inspired by natural and social behaviors and their application in swarm-based optimization algorithms. 3. **Discuss** the exploration and exploitation strategies used in metaheuristic algorithms to efficiently search complex solution spaces. 4. **Apply** evolutionary computation operators to solve discrete and combinatorial optimization problems. 5. **Apply** swarm-based metaheuristic algorithms to optimize real-world engineering and image processing problems.
Textbooks: 1. Vasuki, A. Nature-Inspired Optimization Algorithms. 1st ed., CRC Press, 2020
Reference Books: 1. Bio-Inspired Artificial Intelligence: Theories, Methods, and Technologies, Dario Floreano and Claudio Mattiussi, MIT Press, 2008. 2. Introduction to Evolutionary Computing, A.E. Eiben and J.E. Smith, Springer, 2nd Edition, 2015
Web link 1. NPTEL - Introduction to Soft Computing: https://nptel.ac.in/courses/106105173/ 2. Virtual Lab on Soft Computing: https://vlab.co.in/ 3. MIT OpenCourseWare - Bio-Inspired Robotics & AI: https://ocw.mit.edu/

IoT for Automation			
Semester	**VII**	CIE Marks	**50**
Course Code	**23AIOE411**	SEE Marks	**50**
Teaching Hours/Week (L:T: P)	**3:0:0**	Exam Hrs	**3**
Total Hours	**42**	Credits	**3**

Course Learning Objectives: This course is designed to

1. **Provide** knowledge on the evolution of industrial automation, from traditional control systems to modern IoT-enabled Systems.
2. **Impart** knowledge on Local Automation Clouds, including their properties, establishment and applications.
3. **Impart** knowledge on IoT application automation systems to address industrial and societal challenges.

Module 1: Local Automation Clouds — **No. of Hrs: 9**

The Local Cloud Concept, Local Cloud Properties, Local Cloud Establishment, Automation Support, Automation Application Engineering in Local Clouds, Latency in Local Clouds, Security in Local Clouds, SoS Scalability.

The Arrow Head Framework architecture: Important definitions, Documentation structure, The mandatory core systems, Automation support core systems.

Text Book: Chapter 2, Chapter3.2, 3.3, 3.4.1 (3.4.1.1 to 3.4.1.3), 3.4.2 (3.4.2.1 to 3.4.2.9)

Module 2: Arrowhead Framework core systems and services — **No. of Hrs: 9**

Service Registry system, Authorization system, Orchestration system, Plant Description system, Configuration system, System Discovery and Device Discovery services.

Text Book :Chapter 4.2.1, 4.2.2, 4.2.3, 4.3.1, 4.3.2, 4.3.3

Module 3: Engineering of IoT Automation Systems — **No. of Hrs: 8**

Introduction, Component-based Engineering Methodology, Safety and Security Engineering of IoT Automation Systems, Swift Deployment and Configuration, PLC device monitoring, Replacement of device.

Text Book :Chapter 6.1, 6.3, 6.4, 6.5.2, 6.5.3, 6.5.4

Module 4: Application System Design Energy Optimization — **No. of Hrs: 8**

Introduction, Market as an Energy Optimizing Method, Optimizations Based on a Virtual Market of Energy, Energy Optimization on Lifts, Context Aware Streets, Optimization of Municipal Service Systems.

Text Book :Chapter 7

Module 5: Complex Systems Management, Automation and Security — **No. of Hrs: 8**

Electric Vehicles and Recharge Infrastructure, Arrowhead SOA EM Solution, Systems and Services, Arrowhead EM Services and Related Automation Aspects, Co-simulation Platform. Smart Maintenance Use Case, Authentication and Certification Service, Safety and Security Analysis for Identifying System Vulnerabilities.

Text Book :Chapter 9.4, 9.5, 9.6, 9.7, 9.8;Chapter 10.2, 10.3, 10.5

Course Outcomes: At the end of the course, the student will be able to

1. Describe the concept, architecture, and properties of Local Automation Clouds, including latency, security, scalability, and the Arrowhead Framework for industrial automation.
2. Apply Arrowhead core systems to enable service discovery, orchestration, authorization, and inter-cloud communication in IoT automation systems.
3. Describe the component-based engineering methodologies used to design, deploy, and configure safe and secure IoT automation systems for large-scale and dynamic environments.
4. Describe energy-optimized application systems, including virtual energy markets and context-aware automation solutions.
5. Apply systems management and security automation techniques to real-world use cases such as EV infrastructure and smart maintenance systems.

Textbooks:

1. Jerker Delsing, "IoT Automation: Arrowhead Framework", CRC Press, Taylor & Francis Group..

Reference Books:

1. The Internet of Things in the Industrial Sector, Mahmood, Zaigham (Ed.) (Springer Publication).
2. Industrial Internet of Things: Cyber manufacturing System, Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat (Springer Publication).

Web links:

1. https://www.youtube.com/watch?v=HmbUJEShA-8
2. https://www.youtube.com/watch?v=eidD14dXW8s
3. https://www.udemy.com/course/iot-internet-of-things-automation-withesp8266/?srsltid=AfmBOoqqKDLk_fKye1CPIO9QjctFfgHOf1F_Zkmtze8uNRUvmq_9s1-3
4. https://onlinecourses.nptel.ac.in/noc20_cs69/preview

Data Visualization & Analytics			
Semester	**VII**	CIE Marks	**50**
Course Code	**23AIOE412**	SEE Marks	**50**
Teaching Hours/Week (L:T: P)	**3:0:0**	Exam Hrs	**3**
Total Hours	**42**	Credits	**3**

Course Learning Objectives: This course is designed to

1. **Impart** knowledge on exploratory versus explanatory analysis, focusing on the need of effective storytelling for targeted audience.
2. **Familiarize** various approaches of Aesthetics in data visualization for enhancing the interpretability of data
3. **Provide** knowledge on various plots & graph approaches for visualizing the data proportion, distribution & trends in data for better interpretation.
4. **Provide** insights on data visualization approaches for effective interpretation of geospatial & probabilistic data.

Module 1: Introduction	**No. of Hrs: 09**

Importance of context : Exploratory vs. explanatory analysis, Defining : Who - Identifying Audience, What- Audience Expectation, How - Presenting mechanism, The 3-Mintue Story, Big Idea, StoryBoarding

Handling Clutter : Cognitive Load, Clutter, Gestalt Principles :Proximity, Similarity, Enclosure, Closure, Contineuty, Connection, **Lack of Visual Order : Alignment, White Spaces, Decluttring Example**

Text Book 1: Chapter 1, 3

Module 2 : Aesthetics in Data Visualization	**No. of Hrs: 08**

Introduction, **Visualizing Data:** Aesthetics and Types of Data, Scales Map Data Values onto Aesthetics, **Coordinate Systems and Axes**: Cartesian Coordinates, Nonlinear Axes, Coordinate Systems with Curved Axes, **Color Scales:** Color as a Tool to Distinguish, Color to Represent Data Values, Color as a Tool to Highlight, **plots and charts** : Bar Graph, Grouped & Stacked Bar Graph, Heatmap

Text Book 2: Chapter 1,2,3,4,6

Module 3 : Visualizing Distributions	**No. of Hrs: 09**

Visualizing Distributions: Single Distribution, Multiple Distrubution, **Cumulative Distribution Functions**: Empirical Cumulative Distribution Functions, Highly Skewed Distribution, Quantile-Quantile Plots, **Visualizing Many Distributions**: boxplots, violin plots, Strip Charts, sina plots, ridgeline plot, **Visualizing Proportions:** Pie Chart, side-by-side bars, Stacked Bars, Stacked Densities, Relative Proportions

Text Book 2: Chapter 7,8,9,10

Module 4 : Visualizing Proportions & Trends	No. of Hrs: 08

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Visualizing Nested Proportions: Nested Proportions Issues, Mosaic Plots, Treemaps, Nested Pies, Parallel Sets, **Visualizing Associations**: Scatterplots, Correlograms, Dimension Reduction, Paired Data, **Visualizing Time Series:** Individual Time Series, Multiple Time Series and Dose–Response Curves, **Visualizing Trends:** Smoothing, Showing Trends with a Defined Functional Form, Detrending and Time-Series Decomposition.

Text Book 2: Chapter 11,12,13,14

Module 5 : Visualizing Geospatial & Uncertainty data	No. of Hrs: 08

Visualizing Geospatial Data: Projections**,** Layers**,** Choropleth Mapping**,** Cartograms
Visualizing Uncertainty: Framing Probabilities as Frequencies, Visualizing the Uncertainty of Point Estimates, Visualizing the Uncertainty of Curve Fits**,** Hypothetical Outcome Plots

Text Book 2: Chapter 15,16

Course Outcomes: At the end of the course, the student will be able to

1. **Explain** the concepts of exploratory and explanatory analysis & discuss the need of storytelling for targeted guidance
2. **Identify** various clutters in data visualization and discuss various approaches for incorporating Aesthetics in Data Visualization.
3. **Illustrate** the significance of various plots & graph approaches used in visualizing distribution, proportion, trends in data.
4. **Explain** the approaches used for visualizing geospatial data & uncertainty probabilistic data for effective interpretation.
5. **Compare & discuss** the pros & cons of various approaches used for data visualization

Textbooks:

1. Cole Nussbaumer Knaflic, "Storytelling with Data: A Data Visualization Guide for Business Professionals" Wiley Publisher, 2015
2. Claus O. Wilke, "Fundamentals of Data Visualization", O'Reilly Media, 2019

Reference Books:

1. Effective Data Storytelling: How to Drive Change with Data, Narrative and Visuals, WILEY Publisher, 2020.
2. Data Visualization: Exploring and Explaining with Data with MindTap, Cengage Learning India Pvt. Ltd, 2022.

Web link

1. Youtube Chanllel on Storytelling based on Data https://www.youtube.com/channel/UCjhGlILWNloXJdR2NTCBMlA
2. Data to visualization various graphs : https://www.data-to-viz.com/

Software Testing			
Semester	**VII**	CIE Marks	**50**
Course Code	**23AIOE413**	SEE Marks	**50**
Teaching Hrs/Week (L:T: P)	**3:0:0**	Exam Hrs	**03**
Total Hrs	**42**	Credits	**03**

Course Learning Objectives: This course is designed to

1. **Impart** knowledge on basics of software testing.
2. **Impart** knowledge on different types of software testing.
3. **Provide** knowledge on building test cases for a given application.
4. **Provide** knowledge on effective test planning.
5. **Impart** knowledge on automated testing process and Selenium tool.

Module 1: Basics of Software Testing	**No. of Hrs: 8**

Introduction to software testing, Approaches to testing, Principles of Testing, Salient Features of good testing, Test Policy & Planning, Challenges in testing, Cost Aspect of testing, Testing Process.

Textbook 1: Chapter 3 (3.3, 3.4. 3.12, 3.13, 3.14, 3.16, 3.20, 3.23, 3.31)

Module 2: Functional and Non-Functional Testing	**No. of Hrs: 9**

Boundary value analysis, Test cases for the Triangle problem, Equivalence class testing, Equivalence class test cases for the Triangle problem, Security testing, Performance testing, Recovery testing, Installation testing.

Textbook 2: Chapter 5 (5.1, 5.2), Chapter 6 (6.1, 6.2)

Textbook 1: Chapter 11 (11.5, 11.6. 11.7, 11.8)

Module 3: Structural Testing	**No. of Hrs: 9**

Program Graphs, DD paths, Basis path testing, Guidelines and observations, Definition-Use testing, Slice based testing, Program slicing tools.

Textbook 2: Chapter 8 (8.1, 8.2, 8.4, 8.5) Chapter 9 (9.1, 9.2, 9.3)

Module 4: Test planning and Test cases	**No. of Hrs: 8**

Content of test policy, Content of test strategy, Test plan, Test plan template, Building test data and test cases, Teat scenario, test cases, Template for test cases, Test management software.

Textbook 1: Chapter 14 (14.3, 14.5, 14.6, 14.7, 14.10, 14.15, 14.16, 14.17, 14.19, 14.21)

Module 5: Selenium - Testing tool	**No. of Hrs: 8**

Test Automation, Test Automation environment, Getting Started with Selenium IDE, Installing Selenium-IDE, Recording a script with IDE, Save the test case, Create Selenium Test Suite, Format of Selenium Test, Selenium Test Case writing in HTML, Applying CSS to Selenium Test Cases.

Textbook 3: Chapter 1, 2, 6, 9

Course Outcomes: At the end of the course, the student will be able to

1. Describe the basic concepts of software testing.
2. Articulate various types of software testing techniques, their advantages, disadvantages and significance of testing in software development process.
3. Write effective test cases for the given software systems.
4. Develop elaborate testing plans for the hypothetical project.
5. Test software systems using Selenium and create testing reports.

Textbooks:

1. M G Limaye,"SoftwareTesting Principles, Techniques and Tools",Tata McGraw Hill,2012.
2. Paul C. Jorgensen,"Software Testing, A Craftsman's Approach", 4th Edition, Auerbach Publications, 2014.
3. Ashish Mishra and Aditya Garg, "A Practitioner's Guide to Test Automation usingSelenium", Tata McGraw Hill, 2012.

Reference Books:

1. Elfriede Dustin, "Effective Software Testing" Pearson Education, 2007.
2. Aditya P Mathur: Foundations of Software Testing, Pearson Education, 2008.
3. Unmesh Gundecha, Satya Avasarala,"Selenium WebDriver 3 Practical Guide"–SecondEdition2018.

Activities/Assignments:

1. Develop a Mini Project with documentation of suitable test-cases and their results to perform automation testing of any E-commerce or social media web page using Selenium.

Web links:

1. Software Testing Course, IIT, Kharagpur https://nptel.ac.in/courses/106/105/106105150/
2. Software Testing Course, NPTEL https://onlinecourses.nptel.ac.in/noc19_cs71/preview
3. Software Testing Course, IIT, Madras https://www.youtube.com/watch?v=OGImfxO2TEU&t=10s
4. Lecture series on Software Testing https://www.youtube.com/watch?v=Q50ZyydS7pI

Project Phase – II			
Semester	**VII**	CIE Marks	**100**
Course Code	**23AISE409**	SEE Marks	**100**
Hrs/Week (L: T: P)	**0:0:12**	Exam Hrs	**3**
		Credits	**6**

Objectives: This course is designed to

1. Enable students to execute, validate, and communicate the engineering solution to the identified problem conceptualized in Project Phase – I
2. Motivate students to extend their project work toward research publications, patent filing, funding proposals, or technology transfer, where applicable

General Guidelines for CIE procedure:

1. The Department project coordinator will take the responsibility of monitoring all the activities related to the project execution.
2. The HOD shall constitute project evaluation/review committee(s) & the composition shall be as follows:
   a. HOD or one of the HODs in case of an interdisciplinary project, shall be the Chairman of the committee
   b. Project Coordinator shall be member - Convener
   c. Project guide shall be the member
   d. One/Two senior faculty members nominated by the HOD (may be from different departments in case of an interdisciplinary project jointly nominated by the HODs)
3. Project teams must implement the problem identified using the proposed methodology through systematic experimentation and/or simulation leading to a functional solution or validated outcome in consultation with their project guide.
4. Each project team shall maintain a project diary and record their project progress at regular interval of time. This shall carry signature of the students and the project guide.
5. Marks may be equally or proportionally distributed among team members based on contribution assessed by the guide and committee.
6. A student shall obtain minimum of 40% of the total CIE marks to gain eligibility for SEE

General Guidelines for SEE procedure:

1. The Department project coordinator will take the responsibility of all the requirements for successful conduction of the SEE.
2. SEE for project work will be conducted by two examiners (one internal examiner and the other an external examiner) appointed by the Controller of Examinations.
3. Project teams must present their projects that have been executed and completed with a functional solution or validated outcome during the SEE.

4. Each project team shall bring to the SEE a project report that shall carry signature of the students, project guide, HOD and the Principal. Plagiarism, data fabrication, or copying of work will result in stringent disciplinary action and /or penalties. (Note: Any disciplinary actions or penalties will be as per institutional policy.)
5. Marks may be equally or proportionally distributed among team members based on contribution assessed by the examiners.
6. A student shall obtain minimum of 40% of the total SEE marks to pass this course.

Deliverables:

1. Comprehensive Project Report comprising of:
   - Abstract
   - Introduction
   - Literature Survey
   - Problem Definition
   - Proposed Methodology
   - Design
   - Implementation
   - Results and discussion
   - References
   - Appendices

   The project report shall be prepared in the prescribed format provided by the institute.
2. A plagiarism report shall be obtained from the Department of Library. Acceptable similarity threshold is generally below 20%, and hence, the plagiarized content shall not exceed 20%. Similarity above 20% will require resubmission after proper revisions.

Review and Evaluation for CIE:

1. There shall be two reviews and a presentation. Total of 100 CIE marks is distributed as follows:

Review - 1	
Phase wise execution of proposed solution	20 Marks
Use of modern tools for proposed solution	10 Marks
Contribution as an individual and team member	10 Marks
Total	**40 Marks**
Review - 2	
Complete Implementation and Demonstration of Modules	15 Marks
Report Quality & Formatting	15 Marks
Total	**30 Marks**

Presentation	
Presentation	20 Marks
Team work	10 Marks
Total	**30 Marks**
Grand Total	**100 Marks**

2. First review shall be conducted after one month from the start of the semester.
3. Every department shall develop rubrics to assess performance of the students based on the above given parameters.

Evaluation for SEE:

1. There shall be a presentation for SEE. Total of 100 SEE marks is distributed as follows:

SEE	
Execution of proposed solution	40 Marks
Evaluation of Project Report	30 Marks
Project presentation & Question and Answer	30 Marks
Total	**100 Marks**

Course Outcomes: At the end of the course, the student will be able to

1. Execute the problem identified using the methodology proposed through systematic design, development, experimentation, and/or simulation, leading to a functional solution or validated outcome
2. Translate theoretical concepts into practical implementation while considering constraints such as feasibility, cost, sustainability, safety, ethics, and societal relevance
3. Exhibit the resourcefulness to act independently as well as collaboratively within a team in overcoming technical challenges encountered during project execution
4. Plan tasks effectively, manage time and resources, meet defined milestones, and adhere to deadlines, reflecting professional engineering practice
5. Prepare a comprehensive project report that clearly documents design decisions, implementation details, experimental results, analysis, and conclusions using standard technical writing practices
6. Confidently present the project work through reviews, demonstrations, seminars, and viva-voce examinations, addressing questions from peers, faculty, and examiners

INTERNSHIP			
Semester	VIII	CIE Marks	100
Course Code	23AISE431	SEE Marks	100
Hours/Week (L: T: P)	-	Exam Hours	03
Total Hours	-	Credit	12

Objectives: This course is designed to

1. Bridge the gap between academic learning and real-world engineering practice.
2. Provide hands-on experience in industry, researchand incubation environments.
3. Develop technical, analytical, and professional skills.
4. Expose students to organizational structure, workflow, and workplace ethics.
5. Enhance employability, innovation, and lifelong learning capabilities.

Preamble:

Internship refers to the position of a student as trainee or a temporary (or unconfirmed) employee, who works in an organization, with or without pay/stipend, in order to gain work experience or satisfy requirements for a qualification. It is a structured, supervised professional experience in an industry, research organization, or incubation centers.

Internships play a vital role in bridging the gap between theoretical education and professional practice. In general, engineering internships serve as a crucial component of professional education by providing experiential learning, industry readiness, and holistic skill development, ultimately producing competent engineers or entrepreneurs. Apart from these, it develops professional ethics, work culture awareness and communication skills.

Types of Internships:

Following are the types of internships:

i. **Industry Internship:**Carried out in the engineering industry, companies, manufacturing units, startups, business, IT industry. The topic involved may be technical, managerial, production-related tasks, live projects, or innovative activities.

ii. **Research Internship:**Carried out at universities, research labs, or R&D departments or organizations. The internship involves literature review, data analysis, and experimental work leading to publications, prototypes, technical reports or innovations. The research internship may induce students to plan for higher studies or academic careers.

iii. **Entrepreneurship Internship:**Undertaken in association with start-ups, or entrepreneurship cells or launching own idea inPreincubation/Incubation centers. The internship offers exposure to business planning, prototype, product development, and promotes innovation, risk-taking, and entrepreneurial mindset.

iv. **Post-Placement Internship:** Refers to the internship offered to students after they receive a confirmed job offer (placement) from a company, but before formally joining as full-time employees. This internship (on-site, virtual, or hybrid) ensures that students are groomed to be professionally ready, technically competent, and culturally aligned with the organization even before official induction.

General Guidelines:

1. The official engagement period of 15-week for students selected/recruited by the company/ organization only at their premises under the supervision of the company, shall only be considered as an internship.
2. The period of training and working of students who have been recruited as employees by organizations at the beginning of the 4th year of the program, shall also be treated as an internship.
3. The assigned faculty mentor/coordinator/guide should monitor the student's progress, and document offer letters, training reports, attendance, and evaluations for awarding academic credits.
4. All students undergoing an internship, should adhere to all the guidelines, reporting protocols, and evaluation procedures prescribed by the Institution and the company.
5. Students must submit the certificate of completion of an internship with the period of internship clearly mentioned, from the respective company/organization.

Procedure for CIE:

1. The DepartmentInternship coordinator identified by the HOD will take the responsibility of monitoring all the activities related to the Internship.
2. The HODshall constitute Internal Internship evaluation/review committee & the composition shall be as follows:
   a. HOD shall be the Chairman of the committee
   b. Internship Coordinator shall be member –Convener
   c. Internal InternshipGuide shall be member
   d. Two senior faculty members nominated by the HOD shall be the members
3. The External Internship evaluation/review committee shall be composed of industry supervisor/external guide. For evaluation,the industry supervisor/external guidemay join the review in online mode.
4. The internal evaluation shall be conducted by the departmental review committee based on the student's internship progress, documentation,and presentation which will comprise the student's daily report, focusing on the regularity, completeness, and clarity of the internship logbook/diary; the deliverables and outcomes, considering the

quality of work, relevance, and achievement of the stated objectives; and the presentation skills, assessing clarity, communication effectiveness, and the ability to present the work in a structured and professional manner.

5. The external evaluation shall be carried out by the industry supervisor/external guide based on the student's performance at the workplacewhich will comprise the student's technical knowledge, assessment of the understanding and application of domain-specific concepts during the internship; work ethics, considering professionalism, punctuality, discipline, and adherence to organizational practices; deliverables and outcomes, evaluating the quality and completion of assigned tasks; and the ability to learn independently, adapt to new and emerging technologies, and exhibit critical thinking, reflecting the student's capacity for continuous learning, problem-solving, and adaptability in a professional environment.

Procedure for SEE:

1. SEE for Internship will be conducted by two examiners (one internal examiner and the other an external examiner) appointed by the Controller of Examinations.
2. Studentsmust present their Internship work to the examiners.
3. Each student shall bring to the SEE, an Internship report which includes the Internship Completion Certificate from the organization. The report shall also carry signatures of the student, Internship guides (Internal & External), HOD and the Principal.

Deliverables:

1. Internship Daily Report
2. Final Internship Report
3. Internship Completion Certificate

Evaluation for CIE:

There shall be two reviews and a presentation. Total of 100 CIE marks is distributed as follows:

Review – 1& 2 (Internal Internship Evaluation Committee)	
Internship Daily Report	10 Marks
Deliverables and Outcomes	10 Marks
Presentation Skills	05 Marks
Review – 1 Total	**25 Marks**
Review – 2 Total	**25 Marks**
Review – 1& 2 (External Internship Evaluation Committee)	
Technical Knowledge	10 Marks

Work Ethic	05 Marks
Deliverables and Outcomes	05 Marks
Ability to Learn, Adapt & Critical Thinking	05 Marks
Review – 1 Total	**25 Marks**
Review – 2 Total	**25 Marks**
Grand Total	**100 Marks**

Evaluation for SEE:

Total of 100 SEE marks is distributed as follows:

SEE (Internal & External Examiners)	
Internship Report	70 Marks
Final Presentation	30 Marks
Grand Total	**100 Marks**

Course Outcomes:

At the end of the course, the student will be able to:

CO1: Apply engineering knowledge to real-world industrial or societal problems.

CO2: Demonstrate technical competency in a professional environment.

CO3: Analyze and solve practical engineering problems using modern tools / techniques.

CO4: Communicate effectively through reports and presentations.

CO5: Exhibit professional ethics, teamwork, and adaptability.

CO6: Inculcate industry practices, workflows, and organizational behavior.

PUBLICATION / PATENTING			
Semester	VIII	CIE Marks	100
Course Code	23AISE432	SEE Marks	-
Hours/Week (L: T: P)	-	Exam Hours	-
Total Hours	-	Credit	02

Objectives: This course is designed to

1. Enable students to systematically document literature review and research gaps.
2. Train students in research paper writing and publication process.
3. Provide knowledge of patentability search and drafting patent applications.
4. Motivate students to publish research work or file patents.
5. Inculcate ethical research practices.

Procedure for CIE:

1. The project guide from Project Phase I / II shall continue as the research guide, ensuring continuity in converting the completed project work into a research publication or patent.

2. Students shall derive research contributions from their completed project work, focusing on:
   a. Accurately representing experimental results
   b. Providing evidence for validated outcomes / effective performance
   c. Explicit mention of novelty / innovation

3. The evaluation shall be carried out based on the following three major components:
   Component 1: Literature Review & Manuscript / Patent Drafting
   a. Comprehensive literature survey and identification of research gap
   b. Structuring of research paper / patent document
   c. Technical depth, methodology, and clarity of presentation
   d. Patentability analysis (in case of patent track)

   Component 2: Submission / Filing
   a. Submission of manuscript to a reputed Scopus /SCI/WoS indexed journal
   OR
   Filing of a patent application with appropriate authority
   b. Submission proof (acknowledgement / application number) is mandatory

   Component 3: Publication / Patent Outcome
   Publication of article in Scopus /SCI/WoS indexed journal
   OR
   Publication of patent

4. Marks shall be awarded proportionately based on:
   a. Paper publication status (accepted / published)

b. Patent filing / publication status

5. Students must ensure originality and adherence to ethical practices, including proper citation and avoidance of plagiarism.

6. A plagiarism report shall be submitted, with similarity generally not exceeding 10%, failing which revision and resubmission is required.

7. Progress shall be monitored through periodic reviews by the departmental committee, focusing on:
   a. Conversion of project work into quality manuscript/ patent
   b. Quality of manuscript/patent drafting
   c. Readiness for submission/publication

8. The HODshall constitute publication/patenting evaluation/review committee(s) & the composition shall be as follows:
   a. HOD or one of the HODs in case of an interdisciplinary project, shall be the Chairman of the committee
   b. Coordinator shall be member -Convener
   c. Guide shall be the member
   d. One/Two senior faculty members nominated by the HOD (may be from different departments in case of an interdisciplinary project jointly nominated by the HODs)

Deliverables:

1. Literature Review Report / Patentability Report
   a. Representation of problem identification
   b. Representation ofgap analysis
   c. Survey of recent literature / prior art

2. Manuscript / Patent Draft
   Structured manuscript (Abstract, Introduction, Methodology, Results, References)
   OR
   Patent Draft (Title, Abstract, Claims, Description, Drawings)

3. Submission Proof
   Journal submission acknowledgement / Patent filing receipt

4. Paper Publication / Patent Filing/ Patent Publication Evidence

Evaluation for CIE:

Total of 100 CIE marks is distributed as follows:

Sl. No.	Description	Marks
1.	Literature Review, Research Paper Writing / Patentability Search, Drafting the Patent Application	50
2.	a. Submission & Acceptance of manuscript (Scopus/SCI/WoS) OR b. Filing a Patent Application	30
3.	a. Publication of Article (Scopus/SCI/WoS) OR b. Publication of Patent	20
	Total	**100**

Course Outcomes:

At the end of the course, the student will be able to:

CO1. Systematically document literature review and gaps in a specific domain.

CO2.Prepare a structured research manuscript or patent document following standard guidelines.

CO3 Perform patentability search and analyze prior art for innovation feasibility.

CO4. Demonstrate the ability to submit research work to journals or file patent applications.

CO5. Apply ethical practices in research, including plagiarism avoidance and proper citation.

Constitution of India and Professional Ethics			
Semester	**VII**	CIE Marks	**100**
Course Code	**23HMCC421**	SEE Marks	**-**
Teaching Hours/Week (L:T:P)	**1:0:0**	Exam Hrs	**-**
Total Hours	**13**	Credits	**01**

Course Learning Objectives:

This course is designed to

1. Introduce the foundational principles and features of the Indian Constitution
2. Familiarize the Fundamental Rights and Directive Principles.
3. Provide an understanding of Union and State government policies and Electoral Process.
4. Develop awareness on Sustainable development goals, energy conservation and climate change
5. Inculcate Ethical responsibilities and Code of Conduct.

Module 1: Introduction to the Indian Constitution	**No. of Hrs:2**

Definition and Significance of the Constitution, Making of the Constitution, Constituent Assembly, Preamble, Salient features of the Indian Constitution, Amendments, Schedules and Citizenship.

Module 2: Fundamental Rights and Duties	**No. of Hrs:4**

Fundamental Rights: Right to Equality, Right to Freedom, Right to Life & Personal Liberty, Right against Arbitrary arrest and Preventive Detention, Right against Exploitation, Right to Religion, Cultural & Educational Rights and Right to Constitutional Remedies, Restrictions and Limitations, Directive Principles of StatePolicy and its relevance in the society, Fundamental Duties of Citizens.

Module 3: Union and State Government Structure	**No. of Hrs:3**

Union Govt: Union Legislature- Parliament-Lok Sabha and Rajya Sabha, Sessions of Parliament, Parliamentary System, Parliamentary Committees, Important Parliamentary Terminologies.

Union Executive– President,Prime Minister, Union Cabinet, Union Council of Ministers.

Union Judiciary-Supreme Court of India, Judicial Review and Judicial Activism.

State Govt: State Legislature- State Legislative Assembly, State Legislative council,

State Executive- Governor, Chief Minister, State Cabinet, State Council of Ministers,

State Judiciary- High Court and Subordinate Courts.

Elections: ElectionCommission of India, Process and Laws. **Emergency Provisions**

Module 4: Ethics and Sustainable Development	**No. of Hrs:2**
Ethics: Values and types, Honesty, Trust, Integrity and Reliability in Engineering, Sustainable development goals, energy conservation, sustainable developments, Environmental Ethics: climate change and ethical responsibility.	
Module 5: Professional Ethics for Engineers	**No. of Hrs:2**
Scope & Aims, Code of Ethics, Professional responsibility, Accountability, Research Ethics, Clash of Ethics (example with respect to technology), Conflicts of Interest, Risks, Safety, Liability and Corporate Social Responsibility.	

Course Outcomes:

At the end of the course, the student will be able to:

CO1: State the preamble and the basic features of the Indian Constitution.

CO2:Explain the Fundamental Rights, Directive Principles of State Policy and their relevance in contemporary Indian society.

CO3: Compare the functioning of the Union and State legislature, Executive and Judiciary

CO4: Classify Ethical, Virtues and explain sustainable development goals and climate change.

CO5:Outline the Aims, Code of Ethics, and principles of Corporate Social Responsibility.

TEXT BOOKS

1. Raja Ram, M., (2015), ***Constitution of India & Professional Ethics***, (3rd Edition), New Age International Publishers.
2. Dr. Tharanath, Santhosh Prabhu & Suma Suresh Kogilgeri,(2018), ***Constitution of India & Professional Ethics***, Pristine Publishing House.
3. Sharma Brij Kishore, (2011), ***Introduction to the Constitution of India***, (8th Edition), PHI Learning Pvt. Ltd.
4. Charles E Harris, Michael S. Pritchard & Michael J. Rabins (2018), ***Engineering Ethics: Concepts and Cases***), (1st Edition), IEEE / Cengage.
5. Iqbal, Jaquir, (2013), *SDG – **Sustainable Urban Development: Challenges, Achievements & Opportunities***, (1st Edition), Global Vision Publishing House.

Weblinks:

1. Making of the Indian Constitution - https://www.youtube.com/watch?v=Z5nQ4xea9ts
2. Parts, Articles and Schedules of the Indian Constitution - https://www.youtube.com/shorts/TJRdYarLPYI
3. The Indian Constitution - https://www.youtube.com/watch?v=vXvlSXlmkyM
4. Professional Engineering Ethics - https://www.youtube.com/watch?v=SVz6Q7EoBJM
5. Sustainable Development Goals- https://www.youtube.com/watch?v=qAIolKgDPrA