



ST. VINCENT PALLOTTI COLLEGE OF ENGINEERING & TECHNOLOGY, NAGPUR

(An autonomous institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

M. Tech Scheme of Examination & Syllabus 2025-26

COMPUTER SCIENCE AND ENGINEERING (ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING)

SEMESTER I

Sr No.	Course Code	Course Title	Hours Per Week			Credits	Maximum Marks		Total	Minimum Passing Marks	No. of Hrs for ESE
			L	T	P		Continual Assessment	End Sem Examination			
1	25AM101T	Artificial Intelligence	3	-	-	3	40	60	100	50	3
2	25AM101P	Artificial Intelligence Lab	-	-	4	2	25	25	50	25	-
3	25AM102T	Deep Learning	3	-	-	3	40	60	100	50	3
4	25AM102P	Deep Learning Lab	-	-	4	2	25	25	50	25	-
5	25AM103T	Big Data & Analytics	3	-	-	3	40	60	100	50	3
6	25AM103P	Big Data & Analytics Lab	-	-	4	2	25	25	50	25	-
7	25AM104T	Program Elective-I	3	-	-	3	40	60	100	50	3
8	25AM105P	Technical Seminar-1	-	-	4	2	50	-	50	25	-
Total			12	-	16	20	285	315	600		

		July 2025	1.0	Applicable for 2025-26
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A. Basket for Program Elective Courses (PEC)

Semester	Course Code	Name of Course	Credit
I	25AM104T(i)	Natural Language Processing	3
I	25AM104T(ii)	Data Science for Engineers	3
II	25AM204T (i)	Introduction to Large Language Models (LLMs)	3
II	25AM204T (ii)	Advanced R Programming for Data Analytics in Business	3

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FIRST SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
25AM101T	Artificial Intelligence	3	-	-	3	40	60	100

Course Objectives	Course Outcomes
<p>This course is intended</p> <ul style="list-style-type: none"> To Provide an introduction to the fundamentals of Artificial Intelligence, its history, evolution, and applications. To Develop understanding of intelligent agents, their structure, and behavior in various environments. Explore real-world applications and case studies of AI across industries. 	<p>Students will be able to</p> <ul style="list-style-type: none"> Analyze the structure and functionality of intelligent agents using the PEAS model and environment classification. Differentiate between supervised and unsupervised learning approaches Apply knowledge-based reasoning and planning techniques in problem-solving scenarios. Implement basic Natural Language Processing (NLP) techniques such as tokenization and POS tagging. Assess and discuss real-world AI applications in domains like healthcare, finance, and manufacturing.

Unit I : Introduction to AI:	[9Hrs]
History, Evolution, Applications, Branches of AI, Intelligent Agents , PEAS model, Environment types, Agent types	
Unit II : Machine Learning Overview	[9Hrs]
Supervised, Unsupervised, Expert Systems & Planning, Rule-based systems, Inference, Goal Stack Planning	
Unit III : NLP	[9Hrs]
Natural Language Processing, Text Processing, Tokenization, POS Tagging	
Unit IV : Fundamental Computer Vision	[9Hrs]
Computer Vision Basics; Image processing, Feature extraction	
Unit V : Ethical and Societal Impact	[9Hrs]
Ethical and Societal Impact, Bias, Fairness, Privacy, Explainability, Case Studies, AI in Healthcare, Finance, Manufacturing	

Text Books

S.N	Title	Authors	Edition	Publisher
1.	Artificial Intelligence	E. Rich and K. Knight	3 rd Edition	TMH, 2017
2.	Artificial Intelligence and Expert Systems	Dan W. Patterson	-	PHI, 2015
3.	Artificial Intelligence: A Modern Approach	Stuart Russell, Peter Norvig	2 nd Edition	Pearson Education, 2007

Reference Books

S.N	Title	Authors	Edition	Publisher
1.	Artificial Intelligence	Patrick Henry Winston	3 rd Edition	Pearson Edition
2.	Artificial Intelligence and Expert System	Patterson	-	PHI
3.	Artificial Intelligence	R.B. Mishra	-	PHI, India, 2010

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FIRST SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
25AM101P	Artificial Intelligence Lab	-	-	4	2	CA	ESE	Total
						25	25	50

Course Objectives	Course Outcomes
<p>This course is intended</p> <ul style="list-style-type: none">To provide skills for designing and analyzing AI based algorithms.To enable students to work on various AI tools.To provide skills to work towards solution of real-life problems	<p>Students will be able to</p> <ul style="list-style-type: none">Demonstrate problem-solving using logic programming paradigmsAble to use various heuristic search strategies in Artificial Intelligence programsAnalyze the performance of various AI algorithms and models.Evaluate the performance of various AI modelsDesign a custom AI model.



Expt. No.	Title of the experiment
1	Implement uninformed and informed search algorithms (BFS, DFS, A*, Hill Climbing) to solve state-space problems.
2	Demonstrate problem-solving using logic programming paradigms (Prolog / Python-based logic).
3	Perform text preprocessing tasks such as tokenization, lemmatization, and POS tagging for NLP applications.
4	Construct semantic networks and rule-based systems for knowledge representation and reasoning
5	Design and implement chatbot applications using Rasa / NLTK.
6	Develop a simple expert system with inference mechanisms for domain-specific problems.
7	Apply basic image processing techniques (face detection, edge detection) using OpenCV.
8	Integrate AI techniques in a mini-project or case study to address real-world problems.

Text Books

S.N	Title	Authors	Edition	Publisher
1.	Artificial Intelligence	E. Rich and K. Knight	3 rd Edition	TMH, 2017
2.	Artificial Intelligence and Expert Systems	Dan W. Patterson	-	PHI, 2015
3.	Artificial Intelligence: A Modern Approach	Stuart Russell, Peter Norvig	2 nd Edition	Pearson Education, 2007

Reference Books

S.N	Title	Authors	Edition	Publisher
1.	Artificial Intelligence	Patrick Henry Winston	3 rd Edition	Pearson Edition
2.	Artificial Intelligence and Expert System	Patterson	-	PHI
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FIRST SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
25AM102T	Deep Learning	3	-	-	3	40	60	100

Course Objectives	Course Outcomes
<p>This course is intended</p> <ul style="list-style-type: none"> To equip students with knowledge of fundamental concepts of deep learning and model optimization To develop the ability to design and implement advanced neural architectures for image processing To expose students to transfer learning techniques using pre-trained models for efficient problem solving in real-world applications. 	<p>Students will be able to</p> <ul style="list-style-type: none"> Explain the fundamental concepts of deep learning. Implement deep learning models with API. Design, train, and evaluate CNN architectures such as LeNet and AlexNet Apply RNN variants (LSTM, GRU) for sequential data problems Optimize, evaluate, and deploy deep learning models

Unit I : Foundations of Deep Learning	[9Hrs]
Introduction to Deep Learning, Perceptrons, Activation Functions, Neural Networks: Basics and Architectures, Forward/Backward Propagation, Loss Functions	
Unit II : Model Building	[9Hrs]
TensorFlow Basics, Tensors, Operations, Graphs, Sessions, Model Building with TensorFlow, Keras API, Sequential Model	
Unit III : Convolutional Neural Networks (CNNs)	[9Hrs]
Convolution & Pooling Operations, CNN Architectures: LeNet, AlexNet, Applications of CNNs	
Unit IV : Recurrent Neural Networks (RNNs)	[9Hrs]
Recurrent Neural Networks: Time Series Data, LSTM, GRU, Recurrent Neural Networks: Time Series Data LSTM, GRU	
Unit V : Model Optimization, Evaluation, and Deployment	[9Hrs]
.Model Optimization: Dropout, Regularization, Learning Rate Scheduling, Model Evaluation: Confusion Matrix, ROC, Precision/Recall, Deploying Models: TensorFlow Serving, TensorFlow Lite (TFLite), TensorFlow.js (TFJS)	

Text Books

S.N	Title	Authors	Edition	Publisher
1	Deep Learning	Ian Goodfellow, Yoshua Bengio, Aaron Courville	1st Edition,	MIT Press, 2016.
2.	Deep Learning with Python	François Chollet	2nd Edition	Manning Publications, 2021.
3.	Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow	Aurélien Géron	3rd Edition	O'Reilly Media, 2023.

Reference Books

S.N	Title	Authors	Edition	Publisher
1.	Neural Networks and Deep Learning	Michael A. Nielsen	1st Edition	Determination Press, 2015
2.	Neural Networks and Deep Learning: A Textbook	Charu C. Aggarwal	1st Edition	Springer, 2018.
3.	Deep Learning for Natural Language Processing	Palash Goyal, Sumit Pandey, Karan Jain	1st Edition	Apress, 2018.

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FIRST SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
25AM102P	Deep Learning Lab	-	-	4	2	25	25	50

Course Objectives	Course Outcomes
<p>This course is intended</p> <ul style="list-style-type: none">To provide students with a strong foundation in deep learning using TensorFlow and KerasTo develop the ability to design, implement, train, and evaluate neural network models for diverse applications.For experience in building neural networks from scratch, implementing advanced architectures such as CNNs and RNNs, applying transfer learning, and performing hyperparameter tuning.	<p>Students will be able to</p> <ul style="list-style-type: none">Apply TensorFlow operations and automatic differentiation to implement neural network computations.Design and build artificial neural networks, convolutional networks, and recurrent networks for solving real-world tasks.Implement and evaluate transfer learning techniques using pre-trained models such as VGG and MobileNet.Optimize deep learning models through hyperparameter tuning, dropout, and batch normalization.Demonstrate deep learning models in practical scenarios through end-to-end projects and case studies.



Expt. No.	Title of the experiment
1	TensorFlow Basics Tensor operations, gradients
2	Neural Network from Scratch Build simple ANN using Keras/TensorFlow
3	CNN Implementation Image classification using CNN on MNIST/CIFAR
4	RNN Implementation Text generation using LSTM
5	Transfer Learning Using VGG, MobileNet for classification
6	Model Tuning Hyper parameter tuning, dropout, batch normalization
7	Model Deployment Save, load, and deploy TensorFlow models
8	Project / Case Study Deep Learning project

Text Books

S.N	Title	Authors	Edition	Publisher
1.	Deep Learning	Ian Goodfellow, Yoshua Bengio, Aaron Courville	1st Edition	MIT Press, 2016.
2.	Deep Learning with Python	François Chollet	2nd Edition	Manning Publications, 2021.
3.	Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow	Aurélien Géron	3rd Edition	O'Reilly Media, 2023.

Reference Books

S.N	Title	Authors	Edition	Publisher
1.	Neural Networks and Deep Learning	Michael A. Nielsen	1st Edition	Determination Press, 2015
2.	Neural Networks and Deep Learning: A Textbook	Charu C. Aggarwal	1st Edition	Springer, 2018.
3.	Deep Learning for Natural Language Processing	Palash Goyal, Sumit Pandey, Karan Jain	1st Edition	Apress, 2018.

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FIRST SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
25AM103T	Big Data & Analytics	3	-	-	3	40	60	100

Course Objectives	Course Outcomes
<p>This course is intended</p> <ul style="list-style-type: none"> To introduce the fundamentals of Big Data, its characteristics, challenges, and the Hadoop ecosystem for large-scale data storage and processing. To enable students to apply frameworks like MapReduce, Apache Spark, and various data ingestion tools for efficient data analysis. To familiarize students with NoSQL databases, data visualization tools, and real-time analytics for solving domain-specific Big Data applications. 	<p>Students will be able to</p> <ul style="list-style-type: none"> Explain the concepts of Big Data, its characteristics (3Vs), challenges, and the Hadoop ecosystem. Implement data processing using MapReduce and Spark programming models. Apply data ingestion techniques using Sqoop, Flume, and Kafka, and perform structured data querying using Hive and Pig. Demonstrate the use of NoSQL databases (HBase, MongoDB) and data visualization tools (Tableau/Power BI). Analyze real-time Big Data applications and evaluate use cases in domains like Healthcare, Retail, and IoT.

Unit I : Foundations of Big Data and Hadoop Ecosystem	[9Hrs]
Introduction to Big Data, Characteristics (3Vs), Challenges, Hadoop Ecosystem, HDFS, Architecture, Blocks, Replication	
Unit II : Distributed Data Processing with MapReduce and Spark	[9Hrs]
MapReduce Programming Model, Word Count Example, Apache Spark, RDD, Spark SQL, DataFrames, Spark ML	
Unit III : Data Ingestion and Querying Frameworks	[9Hrs]
Data Ingestion Tools, Sqoop, Flume, Kafka Basics, Hive & Pig, Querying Structured Data	
Unit IV : NoSQL Databases and Data Visualization	[9Hrs]
NoSQL Concepts HBase, MongoDB, Data Visualization, Tableau/Power BI basics	
Unit V : Real-Time Big Data Analytics and Applications	[9Hrs]
Real-time Analytics, Streaming with Spark, Big Data Use Cases Healthcare, Retail, IoT	

Text Books

S.N	Title	Authors	Edition	Publisher
1.	Hadoop: The Definitive Guide	Tom White	4 th Edition,	O'Reilly Media
2.	Big Data: Principles and Paradigms	Rajkumar Buyya, Rodrigo N. Calheiros, Amir Vahid Dastjerdi	1 st Edition,	Morgan Kaufmann
3.	Learning Spark: Lightning-Fast Big Data Analysis	Holden Karau, Andy Konwinski, Patrick Wendell, Matei Zaharia	1 st Edition,	O'Reilly Media

Reference Books

S.N	Title	Authors	Edition	Publisher
1.	Mining of Massive Datasets	Anand Rajaraman, Jeffrey D. Ullman	2 nd Edition,	Cambridge University Press
2.	Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data	Chris Eaton, Dirk DeRoos, Tom Deutsch, George Lapis, Paul Zikopoulos	1 st Edition,	McGraw Hill
3.	Big Data Analytics: A Hands-On Approach	Dr. G. K. Vijayalakshmi Pai	1 st Edition,	McGraw Hill Education

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Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
25AM103P	Big Data & Analytics Lab	-	-	4	2	25	25	50

Course Objectives	Course Outcomes
<p>This course is intended</p> <ul style="list-style-type: none"> To provide hands-on experience in working with Big Data tools and technologies such as Hadoop, Spark, Hive, and NoSQL databases. To enable students to perform data ingestion, storage, processing, and querying using industry-standard frameworks. To develop practical skills in real-time analytics, data visualization, and applying Big Data techniques to real-world case studies. 	<p>Students will be able to</p> <ul style="list-style-type: none"> Demonstrate HDFS operations including file upload, download, replication, and command-line usage. Implement MapReduce programs such as Word Count and Inverted Index for large-scale data processing. Apply Spark with Python (PySpark) for RDD and DataFrame transformations. Perform data ingestion using Sqoop and Flume, and query structured data using HiveQL. Execute NoSQL operations in HBase and MongoDB, create visual dashboards using Tableau/Power BI, and analyze real-world case studies with Spark.

Expt. No.	Title of the experiment
1	HDFS Operations File upload/download, replication, commands
2	MapReduce Programming Word count, inverted index programs
3	Spark with Python (PySpark) RDD & DataFrame transformations
4	HiveQL Create tables, run SQL queries
5	Data Ingestion Sqoop import/export, Flume ingestion
6	NoSQL Hands-on HBase CRUD operations, MongoDB queries
7	Data Visualization Tableau/Power BI dashboards
8	Big Data Case Study Analyze real data using Spark

Text Books

S.N	Title	Authors	Edition	Publisher
1.	Hadoop: The Definitive Guide	Tom White	4 th Edition	O'Reilly Media
2.	Big Data: Principles and Paradigms	Rajkumar Buyya, Rodrigo N. Calheiros, Amir Vahid Dastjerdi	1 st Edition	Morgan Kaufmann
3.	Learning Spark: Lightning-Fast Big Data Analysis	Holden Karau, Andy Konwinski, Patrick Wendell, Matei Zaharia	1 st Edition	O'Reilly Media

Reference Books

S.N	Title	Authors	Edition	Publisher
1.	Mining of Massive Datasets	Anand Rajaraman, Jeffrey D. Ullman	2 nd Edition	Cambridge University Press
2.	Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data	Chris Eaton, Dirk DeRoos, Tom Deutsch, George Lapis, Paul Zikopoulos	1 st Edition	McGraw Hill
3.	Big Data Analytics: A Hands-On Approach	Dr. G. K. Vijayalakshmi Pai	1 st Edition	McGraw Hill Education

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FIRST SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
25AM104T(i)	Program Elective-I Natural Language Processing	3	-	-	3	40	60	100

Course Objectives	Course Outcomes
<p>This course is intended</p> <ul style="list-style-type: none"> Introduce the fundamentals of NLP, statistical language models, and deep learning foundations for language understanding. Develop knowledge of modern architectures such as Transformers, pre-training strategies, and parameter-efficient adaptation methods. Foster critical awareness of advanced applications, interpretability, and ethical implications of deploying LLMs. 	<p>Students will be able to</p> <ul style="list-style-type: none"> Explain NLP pipelines, statistical and neural language models, and their evaluation. Implement embeddings, neural architectures (RNN, LSTM, GRU, Transformer), and decoding strategies for NLP tasks. Apply pre-training, prompting, instruction tuning, and alignment methods (e.g., RLHF) for LLM adaptation. Utilize retrieval-augmented techniques and knowledge graphs for open-domain question answering. Critically evaluate state-of-the-art LLMs with respect to performance, interpretability, and ethical considerations.

Unit I : Foundations of Natural Language Processing	[9Hrs]
Introduction to NLP (NLP Pipeline, Applications of NLP), Introduction to Statistical Language Models, Statistical Language Models: Advanced Smoothing and Evaluation, Introduction to Deep Learning (Perceptron, ANN, Backpropagation, CNN), introduction to PyTorch, Word Representation Word2Vec, fastText, GloVe, Tokenization Strategies.	
Unit II : Neural Language Models and Sequence Learning	[9Hrs]
Neural Language Model: CNN, RNN, LSTM, GRU, Sequence-to-Sequence Models, Greedy Decoding, Beam search, Other Decoding Strategies: Nucleus Sampling, Temperature Sampling, Top-k Sampling, Attention in Sequence-to-Sequence Models	
Unit III : Transformers and Pre-trained Language Models	[9Hrs]
Introduction to Transformers : Self and Multi-Head Attention, Positional Encoding and Layer Normalization, Implementation of Transformers using PyTorch, Pre-Training Strategies: ELMo, BERT (Encoder-only Model), Pre-Training Strategies: Encoder-decoder and Decoder-only Models	
Unit IV : Advanced Language Model Adaptation and Retrieval	[9Hrs]
Instruction Tuning, Prompt-based Learning, Advanced Prompting Techniques and Prompt Sensitivity , Alignment of Language Models with Human Feedback (RLHF) Open-book question answering: The case for retrieving from structured and unstructured sources; retrieval-augmented inference and generation, Retrieval augmentation techniques.	
Unit V : Knowledge Graphs and Parameter-Efficient Fine-Tuning	[9Hrs]
Knowledge graphs (KGs): Representation, completion, Tasks: Alignment and isomorphism, Distinction between graph neural networks and neural KG inference, Parameter-efficient Adaptation (Prompt Tuning, Prefix Tuning, LoRA),	

Text Books

S.N	Title	Authors	Edition	Publisher
1.	Speech and Language Processing (3rd Edition, Draft). Prentice Hall.	Jurafsky, D., & Martin, J. H. (2023).	-	Prentice Hall
2.	Neural Network Methods for Natural Language Processing.	Goldberg, Y. (2017)	-	Morgan & Claypool
3.	Deep Learning for Coders with fastai and PyTorch	Howard, J., & Gugger, S. (2020)	-	O'Reilly

Reference Books

S.N	Title	Authors	Edition	Publisher
1.	Attention is All You Need (Original Transformer Paper)	Vaswani, A. et al. (2017)	-	Curran Associates, Inc. (Conference Proceedings)
2.	Retrieval-Augmented Generation (RAG) for Knowledge-Intensive NLP.	Lewis, P., Yih, W., & Zettlemoyer, L. (2020)	-	Curran Associates, Inc.

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Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
25AM104T(ii)	Program Elective-I Data Science for Engineers	3	-	-	3	40	60	100

Course Objectives	Course Outcomes
<p>This course is intended</p> <ul style="list-style-type: none">• Provide strong foundations in R programming and essential mathematical tools for data science.• Develop understanding of linear algebra, probability, and statistics for analyzing and modeling data.• Introduce optimization techniques and frameworks for solving data science problems.• Apply regression, classification, and clustering techniques for real-world data analysis.	<p>Students will be able to</p> <ul style="list-style-type: none">• Apply R programming for data manipulation, analysis, and visualization.• CO2: Demonstrate understanding of linear algebra and statistical concepts relevant to data science.• Formulate and solve optimization problems in the context of data-driven tasks.• Build and evaluate regression and classification models for predictive analytics.• Implement clustering and classification techniques to extract patterns and insights from data.



Unit I : Linear Algebra for Data Science	[9Hrs]
Linear algebra for data science ,Algebraic view - vectors, matrices, product of matrix & vector, rank, null space,solution of over-determined set of equations and pseudo-inverse), Geometric view - vectors, distance, projections, eigenvalue decomposition	
Unit II : Foundations of Statistics and Probability	[9Hrs]
Statistics (descriptive statistics, notion of probability, distributions, mean, variance, covariance, covariance matrix, understanding univariate and multivariate normal distributions, introduction to hypothesis testing, confidence interval for estimates)	
Unit III : Optimization and Data Science Problem Framework	[9Hrs]
Optimization, Typology of data science problems and a solution framework	
Unit IV : Regression Analysis	[9Hrs]
Simple linear regression and verifying assumptions used in linear regression ,Multivariate linear regression, model assessment, assessing importance of different variables, subset selection	
Unit V : Classification and Clustering Techniques	[9Hrs]
Classification using logistic regression,Classification using kNN and k-means clustering	

Text Books

S.N	Title	Authors	Edition	Publisher
1.	An Introduction to Statistical Learning with Applications in R	James, G., Witten, D.	2nd	Springer
2.	R for Data Science	Wickham, H., & Grolemund, G. (2017)	-	O'Reilly Media
3.	Introduction to Linear Algebra	Strang, G. (2016)	-	Wellesley-Cambridge Press

Reference Books

S.N	Title	Authors	Edition	Publisher
1.	The Elements of Statistical Learning: Data Mining, Inference, and Prediction	Hastie, T., Tibshirani, R., & Friedman, J. (2009)	2nd	Springer
2.	Pattern Recognition and Machine Learning	Bishop, C. M. (2006)		Springer
3.	Nonlinear Programming	Bertsekas, D. P. (2016)	3rd	Athena Scientific

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Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
25AM105P	Technical Seminar-1	-	-	4	2	50	-	50

Course Objectives	Course Outcomes
<p>This course is intended</p> <ul style="list-style-type: none">To offer students a chance to investigate and expand their understanding of innovative and emerging technologies..	<p>Students will be able to</p> <ul style="list-style-type: none">Demonstrate an understanding of the fundamental concepts, trends, and significance of various emerging technologies.Analyse the applications and impact of emerging technologies in solving real-world problems across different domains.Develop confidence and self-reliance in exploring, experimenting with, and presenting ideas related to emerging technologies.

Students are required to present seminars on various emerging technologies to explore and deepen their knowledge in specific technical fields, current trends, and industry advancements, thereby enhancing their expertise, critical thinking, and problem-solving abilities within their chosen domain.

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