CURRICULUM AND SYLLABUS

B.Tech. (Honours) *in*
COMPUTER SCIENCE AND ENGINEERING
(Artificial Intelligence)
2024 SCHEME

CURRICULUM

B.Tech (Honours) is an enhanced version of the Bachelor of Technology degree, offering the students the opportunity to undertake additional courses within their own discipline. This pathway allows students to deepen their knowledge in emerging or advanced areas of Engineering relevant to their field of study, providing a stronger foundation for specialized career paths or further academic pursuits.

For the award of B.Tech (Honours) in Computer Science and Engineering (Artificial Intelligence), the student shall fulfill all the curricular requirements for B.Tech in Computer Science and Engineering (Artificial Intelligence) as per SJCET B.Tech Academic Regulations 2024 and shall earn 15 additional credits by undergoing the following courses, which shall be further governed by clause R16 of the Regulations.

Sl.No	Semester	Course Code	Course Name/Type	Weekly hours				Total Marks		Credits
				L	T	P	SS	CIE	ESE	
1	4	24SJHNCAT409	Data Analysis using Python	3	1	0	5	40	60	4
2	5	24SJHNCAT509	Introduction to Large Language Models	3	1	0	5	40	60	4
		24SJHNCAM5XX	Approved MOOC *							
3	6	24SJHNCAT609	Applied Accelerated Artificial Intelligence	3	1	0	5	40	60	4
		24SJHNCAM6XX	Approved MOOC *							
4	7	24SJHNCAT709	Programming with Generative AI	3	0	0	5	40	60	3
		24SJHNCAM7XX	Approved MOOC *							
Total Credits										15

*MOOC to be approved by the Academic Council on recommendation of the Board of Studies.

SEMESTER 4

DATA ANALYSIS USING PYTHON

Course Code	**24SJHNCAT409**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	**ESE Marks**	60
Credits	4	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Theory

Course Objectives:

1. To introduce the fundamentals of data analysis.
2. To enable students to understand the different data pre-processing techniques and data distribution.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Purpose of data analysis, Structured and Unstructured data, Steps of data analysis, Python Packages for Data Analysis: Numpy, Scipy, Matplotlib, Plotyly, NLTK. Data Frames, Usage of frames analytical roles, File handling and reading data for processing, Pre-processing data using multiple python frameworks, Data Formatting, Data Manipulation, Data normalization, Data Merging, Data reshaping, Data Wrangling, Missing value handling, Aggregation function, Data reporting, Data Scrapping using beautifulsoup.	**9**
2	String Manipulations, Demonstrating string functions, A regular expression for data, manipulation, Data Visualization, Using Histograms, Using Boxplots, Plotting data, Venn Diagram, Bar Chart, Pie Chart, Line Chart, Scatter Plots and R2, Grouped charts, Area Charts, Descriptive Statistics, Central tendencies, Analyzing variability.	**9**
3	Data Distributions, Random Variables, Bernoulli Distribution, Binomial Distribution, Normal Distribution, Z score, Statistical Properties, Standard Normal Distribution, Correlation: Pearson correlation method, Exponential distribution, Statistical test, Hypothesis testing, Z-test, Right-tailed test, Two-tailed test, T- Test, Significance of p-value in t-test, Two-sample Z-test, Paired t-test.	**9**
4	Introduction to machine learning system, overview of prediction methods, models for classification problems, Sample implementation of machine learning methods on standard datasets, social impact of data analysis.	**9**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24 marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 subdivisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	To articulate the structured and unstructured data for extracting useful information.	**K2**
CO2	To apply data visualization methods.	**K3**
CO3	To understand data distribution and testing methods.	**K3**

CO4	To apply machine learning methods on standard datasets	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	✓	✓	✓	✓	✓				✓		✓
CO2	✓	✓	✓	✓	✓				✓		✓
CO3	✓	✓	✓	✓	✓				✓		✓
CO4	✓	✓	✓	✓	✓				✓		✓

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Data Analytics using Python	Motwani, Bharti	Wiley	2020
2	Data Science Projects with Python: A case study approach to successful data science projects using Python, pandas, and scikit-learn	Klosterman, Stephen	Packt Publishing Ltd	2019

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Hands-On Exploratory Data Analysis with Python: Perform EDA techniques to understand, summarize, and investigate your data	Mukhiya, Suresh Kumar, and Usman Ahmed	Packt Publishing Ltd	2020

SEMESTER 5

INTRODUCTION TO LARGE LANGUAGE MODELS

Course Code	24SJHNCAT509	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To introduce the fundamental concepts of Natural Language Processing (NLP) and its applications in modern AI systems.
2. To provide a strong understanding of statistical and neural language models, including embedding and sequence modelling techniques.
3. To familiarize students with advanced LLM topics such as retrieval-augmented generation, parameter-efficient adaptation, and interpretability.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Foundations of NLP and Deep Learning:** Overview of NLP and its importance, NLP pipeline and key applications, Introduction to Statistical Language Models, Advanced Smoothing and Evaluation Techniques, Perceptron, Artificial Neural Networks (ANN), Backpropagation, Convolutional Neural Networks (CNN), Introduction to PyTorch.	9
2	**Word Representations and Neural Language Models:** Word Representation Techniques, Word2Vec, fastText, GloVe, Tokenization Strategies, Neural Language Models, CNN, RNN, LSTM, GRU, Sequence-to-Sequence Models, Decoding Strategies (Greedy, Beam Search, Nucleus Sampling, Temperature Sampling, Top-k Sampling), Attention in Seq2Seq Models.	9

3	**Transformers and Pre-trained Language Models:** Transformer Architecture, Self and Multi-Head Attention, Positional Encoding, Layer Normalization, Implementation in PyTorch, Pre-training Strategies, ELMo, BERT (Encoder-only Models), Encoder–Decoder Models, Decoder-only Models, Introduction to HuggingFace, Prompt-based Learning, Instruction Tuning, Advanced Prompting Techniques.	**9**
4	**Advanced NLP Techniques and Responsible AI:** Retrieval-Augmented and Knowledge-based NLP, Retrieval-Augmented Generation (RAG, REALM), Knowledge Graphs (Representation, Completion, Alignment, Isomorphism), Graph Neural Networks vs Neural KG Inference, Efficient Adaptation and Interpretability, Parameter-efficient Adaptation (Prompt Tuning, Prefix Tuning, LoRA), Recent Trends in LLMs (GPT-4, Llama-3, Claude-3, Mistral, Gemini), Ethical NLP (Bias, Fairness, Toxicity).	**9**

Course Assessment Method
(CIE: 40 marks,ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24 marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 subdivisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the fundamental concepts of Natural Language Processing (NLP), statistical models, and deep learning techniques for text understanding.	**K2**
CO2	Develop language models using word representation techniques and neural network architectures.	**K3**
CO3	Understand transformer-based and pre-trained language models, including prompt-based learning and fine-tuning strategies.	**K2**
CO4	Design advanced large language model techniques such as retrieval-augmented generation and parameter-efficient adaptation.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2								2
CO2	3	3	3								2
CO3	3	3	3								2
CO4	3	3	3								2
CO5	3	3	2								2

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Introduction to Large Language Models	Tanmoy Chakraborty	Wiley India	1st Edition, 2025
2	Speech and Language Processing	Daniel Jurafsky, James H. Martin	2nd Edition, 2008	2nd Edition, 2008
3	Introduction to Natural Language Processing	Jacob Eisenstein	The MIT Press	1st Edition, 2019

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Deep Learning for Natural Language Processing	Palash Goyal, Sumit Pandey, Karan Jain	Springer	1/e, 2018
2	Natural Language Processing: A Textbook	Raymond Lee	Springer	1/e, 2025

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1, 2, 3, 4	https://nptel.ac.in/courses/106102576

SEMESTER 6

APPLIED ACCELERATED ARTIFICIAL INTELLIGENCE

Course Code	**24SJHNCAT609**	**CIE Marks**	40
Teaching Hours/Week (L:T:P: R)	3:1:0:0	**ESE Marks**	60
Credits	4	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Theory

Course Objectives:

1. To understand foundations of AI acceleration and modern deep learning frameworks.
2. To develop knowledge about distributed and high-performance computing techniques for implementing accelerated AI workflows

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Foundations of Accelerated AI Systems** Introduction to AI Systems Hardware, Introduction to AI Accelerators and GPUs, Basics of Operating Systems and Virtualization, Cloud Computing Fundamentals, Introduction to Containers and IDE Dockers, Scheduling and Resource Management, DeepOps: Kubernetes and Deployment of AI-based Services, Design Principles for Building High Performance Clusters.	**9**
2	**Deep Learning Frameworks and Optimization** Introduction to PyTorch,Profiling with DLProf and PyTorch Catalyst, Introduction to TensorFlow, Accelerated TensorFlow and XLA Approach, Optimizing Deep Learning Training: Automatic Mixed Precision, Transfer Learning	**9**
3	**Distributed and Accelerated AI Computing** Fundamentals of Distributed AI Computing, Distributed Deep Learning using TensorFlow and Horovod, Challenges with Distributed Deep Learning Training and Convergence, Fundamentals of Accelerating Deployment, Accelerating Neural Network Inference in PyTorch and TensorFlow, Accelerated Data Analytics and Machine Learning	**9**
4	**Applied AI and Domain Implementations** Introduction to Natural Language Processing (NLP), Applied AI: Smart City (Intelligent Video Analytics with DeepStream), Healthcare Applications: Word Embedding and Text Classification using Word Embedding	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24 marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 subdivisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the fundamental concepts of AI system architecture, including hardware accelerators, virtualization, cloud computing, and container-based deployments.	**K2**
CO2	Develop deep learning models using frameworks such as PyTorch and TensorFlow	**K3**
CO3	Understand fundamentals of distributed AI computing	**K2**
CO4	Apply accelerated AI techniques to real-world domains	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓	✓	-	-	-	-	-	-	✓	-
CO2	✓	✓	✓	✓	✓	-	-	-	✓	✓	✓
CO3	✓	✓	✓	✓	✓	-	-	-	✓	-	✓
CO4	✓	✓	✓	✓	✓	-	-	-	✓	✓	✓

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Artificial Intelligence and Hardware Accelerators	Ashutosh Mishra, Jaekwang Cha	Springer	2023
2	Cloud Native Devops with Kubernetes	John Arundel, Justin Domingus	O′Reilly	Second Edition, 2022
3	Natural Language Processing with Spark NLP: Learning to Understand Text at Scale	Alex Thomas	O′Reilly	2020

Reference Books				
Sl. No	**Title of the Book**	**Name of the Editor/s**	**Name of the Publisher**	**Edition and Year**
1	Big Data Analytics and Intelligent Techniques for Smart Cities	Dr. Kolla Bhanu Prakash, Dr. Sanjeevikumar Padmanaban	Taylor & Francis	2021

Video Links (NPTEL, SWAYAM…)	
No.	**Link ID**
1	https://nptel.ac.in/courses/106106238