ST. JOSEPH'S
COLLEGE OF ENGINEERING
AND TECHNOLOGY,
- PALAI -
AUTONOMOUS

Choondacherry P.O., Pala, Kottayam - 686579
Kerala, India

CURRICULUM AND SYLLABUS

B.Tech. (Honours) *in*
COMPUTER SCIENCE AND ENGINEERING
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, the student shall fulfill all the curricular requirements for B.Tech in Computer Science and Engineering 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	24SJHNCST409	Robotic Process Automation	3	1	0	5	40	60	4
2	5	24SJHNCST509	Generative AI and Large Language Models	3	1	0	5	40	60	4
		24SJHNCSM5XX	Approved MOOC *							
3	6	24SJHNCST609	Modern Cryptography	3	1	0	5	40	60	4
		24SJHNCSM6XX	Approved MOOC *							
4	7	24SJHNCST709	Front End Web UI Frameworks and Tools: React Native	3	0	0	5	40	60	3
		24SJHNCSM7XX	Approved MOOC *							
Total Credits										15

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

SEMESTER S4
(Honours)

ROBOTIC PROCESS AUTOMATION

Course Code	24SJHNCST409	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs 30 Mins
Prerequisites (if any)	NA	Course Type	Theory

Course Objectives:

1. To introduce the concept of Robotic Process Automation and UiPath.
2. To design automation workflows using UiPath Studio.
3. To apply UI automation techniques using selectors and OCR.
4. To use Orchestrator for robot deployment and scheduling.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Module 1: Introduction to RPA & UiPath** Definition and need of RPA, RPA vs Traditional Automation, UiPath Platform Architecture – Studio, Robot & Orchestrator Overview, Basics of UI Automation, Interaction with UI elements using selectors, Execution of attended automation workflows. **Module Project:** Develop a basic UI automation process demonstrating interaction with application elements and execution using UiPath Studio.	11
2	**Module 2: Workflows and Data Handling** Sequence, Flowchart and State Machine workflows, Variables and Arguments, Input/Output data handling, Control flow activities, Loops, Data manipulation and data-driven automation. **Module Project:** Design a structured workflow that processes multiple data inputs and generates validated outputs using variables and data handling activities.	11
3	**Module 3: UI Automation with Selectors and OCR** Element identification, Types of selectors, Dynamic selectors and fine-tuning, Anchor-based automation, Screen scraping techniques, OCR-based data extraction from scanned or semi-structured documents. **Module Project:** Build an automation process that extracts screen or document data and enters it into an application using reliable UI selectors.	11
4	**Module 4: Orchestrator, Email & File Automation** Email automation, File and directory handling, Data table operations, Publishing automation workflows, Robot configuration in Orchestrator, Scheduling, Monitoring and Logging automation performance. **Module Project:** Deploy an automation workflow through Orchestrator with scheduling and monitoring, demonstrating enterprise-level robot operation.	11

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

Attendance	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 Outcomes		Bloom's Knowledge Level (KL)
CO1	Describe RPA concepts and UiPath platform components.	K2
CO2	Develop automation workflows using variables and data handling activities in UiPath Studio.	K3
CO3	Implement UI automation using selectors, screen scraping, and OCR techniques.	K3
CO4	Analyze deployment, scheduling, and monitoring using UiPath Orchestrator.	K4

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/Reference Books

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool	Alok Mani Tripathi	Packet Publishers	2018
2	Robotic Process Automation: Guide to Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant	Richard Murdoch	Independent	1st Edition 2018

Video/Web Links (NPTEL, SWAYAM…)
Link ID
https://www.uipath.com/rpa/robotic-process-automation
https://academy.uipath.com/

GENERATIVE AI AND LARGE LANGUAGE MODELS

Course Code	24SJHNCST509	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs 30 Mins
Prerequisites (if any)		Course Type	Theory

Course Objectives:

1. Learn how Generative AI and Transformers work.
2. Use different language models and prompt techniques.
3. Build and improve AI systems using LangChain and fine-tuning.
4. Make AI fair and explore models that use text, images, and sound.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Module 1: Introduction to Generative AI** Introduction to Generative AI- What is Generative AI? Key domains: Text, Image, Music, Video generation, Real-world applications and impact. Evolution of Architectures -Limitations of RNN & LSTM, Rise of Transformer architecture, Why Transformers outperform traditional models. Anatomy of the Transformer- Core components: Encoders, Decoders, Attention mechanisms: Self-attention (focus only on this type), Tokenization and positional encoding, Feed-forward layers and residual connections. Training and Feedback Loops- Introduction to RLHF (Reinforcement Learning from Human Feedback), Overview of RLAIF (brief mention only), Ethical considerations and model alignment **Module Project:** Exploring Transformer Architecture and Text generation with Pre-trained LLMs	11
2	**Module 2: Language Models and Prompt Engineering** Diving into different LLM architectures: BERT (Bidirectional Encoder Representations from Transformers) and its applications, exploring other notable LLM architectures (e.g.GPT-3, T5), Mixture of Experts (MoE), various benchmarks to evaluate LLMs. Introduction to prompt, examples of prompt, prompt engineering, prompt techniques, zero shot, one shot, few-shot learning, a chain of thought prompting, ReAct Prompting, self-consistency, Tree of thought, LLM based Agents, Large Action Models(LAMs). **Module Project:** Evaluate the effectiveness of different prompting techniques on a selected LLM (e.g., GPT-3 or open-source alternatives like LLaMA or Mistral) across multiple NLP tasks.	11
3	**Module 3: Retrieval-Augmented Generation, Fine-Tuning & Evaluation of LLMs** Introduction to Retrieval-Augmented Generation (RAG),how RAG improves factual accuracy and context, simple examples of retrieval and generation. Understanding Vectors and Vector Storage-embeddings and vectors, basics of vector indexing and similarity search, Overview of vector databases (e.g., FAISS, Chroma). LangChain Basics for RAG-	11

	Loading documents using Document Loaders, retrieving information using Retrievers. Fine-Tuning LLMs – Introduction, fine-tuning, Overview of downstream tasks (e.g., classification, summarization), Simple fine-tuning workflows. Lightweight Fine-Tuning Techniques-Introduction to PEFT (Parameter-Efficient Fine-Tuning), LoRA (Low-Rank Adaptation), QLoRA -with memory efficiency. Quantization Basics- quantization, Benefits for deployment and speed. Metrics for Evaluating LLMs- Common metrics: Perplexity, BLEU score, Accuracy. Understanding Bias in LLMs and in AI models, Examples of biased outputs. **Module Project**: Design and deploy a retrieval-augmented Q&A assistant using LangChain, powered by a fine-tuned LLM tailored to a specific domain (e.g., healthcare, legal, education, or finance).	
4	**Module 4: Mitigating bias in LLM development and evaluation and Multimodal architectures** Exploring techniques for mitigating bias in LLM development and evaluation, considering prompt design and data selection for RAG models: RAGAS. Multimodal Architectures - Beyond Text Introduction to Multimodal LLMs: processing and understanding different data types (text, images, audio). Exploring architectures for Multimodal LLMs: separate encoders, joint embedding spaces. Applications of Multimodal LLMs (e.g., image captioning, video summarization), Multi- task LLMs, Empowering Time Series Analysis with Large Language Models. **Module Project**: Build a Bias-Aware Multimodal Q&A Assistant.	11

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

Attendance	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 Outcomes		Bloom's Knowledge Level (KL)
CO1	Explain how transformer models work and why they are important in generative AI.	**K2**
CO2	Apply different prompting techniques to improve the performance of language models.	**K3**
CO3	Build a retrieval-augmented system using LangChain and fine-tune it for specific tasks.	**K3**
CO4	Design a multimodal AI system that reduces bias and handles text and image data together.	**K4**

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/Reference 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	Natural Language Processing with Transformers: Building Language Applications with Hugging Face	Lewis Tunstall, Leandro von Werra, Thomas Wolf	O'Reilly Media	2022
3	Transformers for Natural Language Processing	Denis Rothman	Packt Publishing	2021
4	The Art of Prompt Engineering with ChatGPT	Nathan Hunter	Independently Published	2023
5	Generative AI with LangChain	James Phoenix	Independently Published	2024
6	Multimodal Machine Learning: Techniques and Applications	Paul Pu Liang, Louis-Philippe Morency	Morgan & Claypool Publishers	2022

Video/Web Links (NPTEL, SWAYAM…)
Link ID
https://onlinecourses.swayam2.ac.in/imb24_mg116/preview
https://onlinecourses.nptel.ac.in/noc25_cs45/preview

MODERN CRYPTOGRAPHY
Honours S6

Course Code	24SJHNCST609	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs 30 Mins
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. Understand foundational mathematical structures such as modular arithmetic, group theory, and number-theoretic principles essential for cryptographic systems.

2. Explore and implement symmetric-key cryptographic primitives**,** including stream and block ciphers, and analyze their modes of operation and security properties.

3. Apply cryptographic techniques for message integrity and authentication, using hash functions, MACs, and digital signatures to ensure secure communication.

4. Evaluate classical and post-quantum public-key cryptographic schemes, simulate quantum threats, and assess the resilience of encryption and signature algorithms.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Module 1: Preliminaries and Basic Group Theory :** Primes and Divisibility, Modular arithmetic, Groups, The Group Z^*_N, Isomorphisms and the Chinese Remainder Theorem. Cryptography and Modern Cryptography : The Setting of Private-Key Encryption Historical Ciphers and Their Cryptanalysis, Principles of Modern Cryptography. Perfectly Secret Encryption : Definitions, The One-Time Pad, Limitations of Perfect Secrecy, Shannon's Theorem. **Module Project:** Implement Classical Ciphers Using Modular Arithmetic, Apply Chinese Remainder Theorem to simulate multi-modulus encryption.	11
2	**Module 2: Private-Key (Symmetric) Cryptography** : Modes of Operation and Encryption in Practice : Stream Ciphers, Stream-Cipher Modes of Operation, Block Ciphers and Block-Cipher Modes of Operation. **Practical Constructions of Symmetric-Key Primitives :** Stream Ciphers : Linear-Feedback Shift Registers, Adding Nonlinearity, Trivium, ChaCha20. Block Ciphers : Substitution-Permutation Networks, Feistel Networks, DES, 3DES, AES. **Module Project:** Encrypt sample files and analyse ciphertext patterns. Build a basic LFSR (Linear Feedback Shift Register) in Python or C	11
3	**Module 3: Message Integrity and Authentication :** Hash functions – Security requirements, Secure Hash Algorithm SHA-1, and SHA-2 ,The Sponge Construction and SHA-3 (Keccak). Message Authentication Code (MAC) – Requirements, Uses, Hash-based MAC (HMAC), Generic Attacks on Hash Functions, Cipher-based MAC (CMAC).	11

	Module Project: Implement and analyse cryptographic primitives that ensure message integrity and authenticity using hash functions, MACs, and digital signatures.	
4	**Module 4: Public-Key (Asymmetric) Cryptography and Post-Quantum Cryptography:** Key Management and the Public-Key Revolution : Digital signatures – Attacks, Forgeries, Requirements, Direct vs Arbitrated digital signatures, RSA digital signature, ElGamal digital signature, Digital Signature Standard (DSS). Post-Quantum Cryptography : Post-Quantum Symmetric-Key Cryptography, Grover's Algorithm and Symmetric-Key Lengths, Collision-Finding Algorithms and Hash Functions Shor's Algorithm and its Impact on Cryptography ,Post-Quantum Public-Key Encryption. Post-Quantum Signatures : Lamport's Signature Scheme,Chain-Based Signatures, Tree-Based Signatures. **Module Project**: Implement classical and post-quantum cryptographic schemes, simulate quantum threats, and evaluate the security and performance of digital signatures and public-key encryption.	11

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

Attendance	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 Outcomes		Bloom's Knowledge Level (KL)
CO1	Design and implement classical ciphers and modular encryption schemes using number-theoretic principles and the Chinese Remainder Theorem.	**K3**
CO2	Develop and analyze symmetric-key encryption systems, including LFSRs, Trivium, ChaCha20, and AES, with various modes of operation.	**K3**
CO3	Implement secure message authentication mechanisms, including HMAC, CMAC, and digital signature schemes, and evaluate their resistance to attacks.	**K3**
CO4	Apply post-quantum cryptographic primitives, demonstrating the ability to build and assess quantum-resilient encryption and signature systems.	**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/Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Introduction to Modern Cryptography	Jonathan Katz and Yehuda Lindell	CRC Press (Taylor & Francis Group)	3rd Edition 2020
2	A Computational Introduction to Number Theory and Algebra	Victor Shoup	Cambridge University Press	2nd Edition, 2009
3	Cryptography and Network Security: Principles and Practice	William Stallings	Pearson Education	7th Edition, 2017
4	Understanding Cryptography: A Textbook for Students and Practitioners	Christof Paar, Jan Pelzl	Springer	1st Edition, 2010
5	Post-Quantum Cryptography	Daniel J. Bernstein, Johannes Buchmann, Erik Dahmen (Editors)	Springer	1st Edition, 2009
6	Introduction to Modern Cryptography	Jonathan Katz and Yehuda Lindell	CRC Press (Taylor & Francis Group)	3rd Edition 2020

Video/Web Links (NPTEL, SWAYAM…)
Link ID
https://onlinecourses.swayam2.ac.in/cec24_cs16/preview