

SVSU/CS6/2023/422(d)

Elective course Syllabus

of

B. TECH. COMPUTER SCIENCE AND ENGINEERING (ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING)

By

Skill Department of Computer Science & Engineering
Skill Faculty of Engineering & Technology



w.e.f. Academic Session 2024-25

Shri Vishwakarma Skill University

Dudhola, Palwal-121102, Haryana

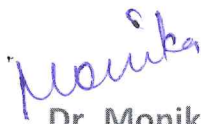
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**It is certified that this Syllabus, developed and checked by us, is
completed in all respects.**



Dr. Monika Jangra

Skill Assistant Professor, Dept of CSE, SFET



Prof. Usha Batra

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Chairperson, Skill Associate Professor,

Skill Department of CS/IT, SFET



Prof. Ashish Srivastava
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Dean, Skill Faculty of Engineering and Technology, SVSU

Prof. Suresh Kumar

Dean, Academic, SVSU

Program Elective III -Human Computer Interface (25UCSE01)							
B. Tech. CSE (AI/ML)							
Semester-VII							
L	T	P	Credits	Core Course	Internal Examination	:	30
3	0	0	3		External Examination	:	70
Effective from Session:				w.e.f. 2025-2026	Total	:	100
Date of BOS approval:					Duration of Exam	:	3 Hrs
Prerequisite							

Course outcome

After successful completion of the course, students will be able to:

CO1: Understand and explain the fundamentals of human cognition and their impact on interface usability.

CO2: Apply user-centered design principles to develop interfaces that meet user needs and preferences.

CO3: Evaluate and improve user interfaces using established HCI evaluation techniques.

CO4: Integrate AI/ML methods to personalize and enhance user interaction experiences.

CO5: Analyze and design intelligent, adaptive, and ethical interfaces for emerging technologies.

Unit I: Introduction to Human-Computer Interaction

Definition, goals, and scope of HCI ; Evolution and importance of HCI in modern computing; Human factors: cognition, perception, motor functions, memory limitations; Interaction frameworks:

Norman's Execution-Evaluation cycle, Abowd & Beale interaction framework ; Overview of AI-driven interfaces: conversational interfaces, recommendation systems ; Applications of HCI in smart environments and human-AI collaboration

Unit II: Principles of User Interface Design

Design rules: Shneiderman's Eight Golden Rules, Nielsen's Usability Heuristics; The user-centered design process: need analysis, persona creation, storyboarding; Prototyping: low-fidelity and high-fidelity; Usability principles: learnability, efficiency, memorability, error handling, satisfaction; Designing for diverse users: accessibility, universal design, W3C standards; Ethical and cultural considerations in interface design

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Unit III: User Interfaces

Command-line interfaces, graphical user interfaces (GUI), menu-based, form-based; Natural interaction: voice, gesture, eye movement, AR/VR interfaces; Tangible and wearable interfaces; Input/output devices: keyboards, touchscreens, haptics, biometric sensors; HCI in mobile and ubiquitous computing; Case studies on multimodal interaction and smart user interfaces in AI systems

Unit IV: User Modeling and Evaluation

User profiling, segmentation, and personalization techniques; Cognitive architectures and behavioral models (GOMS, KLM); Evaluation techniques: heuristic evaluation, cognitive walkthrough, think-aloud protocol; Usability testing: planning, execution, metrics (task time, error rate, user satisfaction); Eye-tracking, clickstream analysis, A/B testing, and user analytics; Case examples of interface improvement through user feedback

Unit V: Intelligent Interfaces and Advanced Trends

Intelligent user interfaces (IUIs): definition and architecture; Adaptive systems: learning from user behaviour using ML techniques ; Affective computing and emotion-aware interfaces; Conversational agents: chatbots, virtual assistants, and NLP integration; Explainable interfaces in AI systems; Ethics, data privacy, and user trust in AI-powered interfaces; Future directions: brain-computer interfaces, immersive HCI in metaverse environments

Textbooks

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, Human-Computer Interaction, Pearson

Reference Books

1. Ben Shneiderman, Catherine Plaisant, Designing the User Interface: Strategies for Effective Human-Computer Interaction, Pearson.
2. Don Norman, The Design of Everyday Things, Basic Books.
3. Jenny Preece, Yvonne Rogers, Helen Sharp, Interaction Design: Beyond Human-Computer Interaction, Wiley.

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Program Elective III- Human Computer Interaction Lab (25UCSE02)							
B. Tech. CSE (AI/ML)							
Semester-VII							
L	T	P	Credits	Core Course	Internal Examination	:	35
0	0	2	1		External Examination	:	15
Effective from Session:				w.e.f. 2024-2025	Total	:	50
Date of BOS approval:				22-7-2024	Duration of Exam	:	3 hrs
Prerequisite							

Course Objective:

After successful completion of the course, students will be able to:

CO1: Design user-friendly GUI applications using Python's Tkinter and related libraries.

CO2: Implement event-driven programming with keyboard and mouse interactions.

CO3: Integrate real-time features like dynamic clocks, quizzes, and task management tools.

CO4: Apply basic computer vision and emotion detection using OpenCV and DeepFace.

CO5: Develop intelligent interfaces using rule-based chatbots and voice-controlled input systems.

List of Experiments:

1. Write a program to build a simple feedback form with text input and rating.
2. Create a simple GUI that takes inputs like Name, Email, Gender, and display them on submission.
3. Write a program to bind mouse click to label update and capture keyboard key press to display in label.
4. Trigger Action with Enter and Escape Keys, for example, Enter to submit and Escape to exit.
5. Create a GUI with two Entry fields. When a field gets focus, change its background to yellow. When it loses focus, revert to white.
6. Create a basic calculator with number and operator buttons.
7. Write a program to display time/clock that updates every second.
8. Design a GUI to select an open file.
9. Write a program to design a task manager that adds and clears tasks.
10. Build a 5-questionnaire quiz and display the score at the end.
11. Build a basic text based chatbot that responds from pre-defined rules.
12. Write a program to use OpenCV to draw rectangle around detected faces.
13. Write a program to load an image and use DeepFace to detect emotion and display feedback.
14. Write a program to display personalized greeting or menu based on user data.

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15. Create a voice-controlled input system (e.g., speak name → enter in field).

Textbooks

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, Human-Computer Interaction, Pearson

Reference Books

1. Ben Shneiderman, Catherine Plaisant, Designing the User Interface: Strategies for Effective Human-Computer Interaction, Pearson.
2. Don Norman, The Design of Everyday Things, Basic Books.
3. Jenny Preece, Yvonne Rogers, Helen Sharp, Interaction Design: Beyond Human-Computer Interaction, Wiley.

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Program Elective III -Quantum Computing (25UCSE03)							
B. Tech. CSE (AI/ML)							
Semester-VII							
L	T	P	Credits	Core Course	Internal Examination	:	30
3	0	0	3		External Examination	:	70
Effective from Session:				w.e.f. 2025-2026	Total	:	100
Date of BOS approval:					Duration of Exam	:	3 Hrs
Prerequisite							

Course Outcomes

After successful completion of the course, students will be able to:

CO1: Understand the principles of quantum mechanics relevant to computing.

CO2: Represent and manipulate quantum states using linear algebra.

CO3: Analyze and design quantum circuits using quantum gates.

CO4: Explore quantum algorithms and their computational advantages over classical algorithms.

CO5: Apply quantum computing models to AI/ML and optimization problems.

Unit I: Foundations of Quantum Computing

Postulates of quantum mechanics; Qubits and quantum states; Dirac notation and vector spaces; Quantum superposition and entanglement; Quantum measurement; Quantum gates and circuits; Comparison with classical computing

Unit II: Quantum Logic Gates and Circuits

Single-qubit gates: Pauli-X, Y, Z, Hadamard, Phase, T-gate; Multi-qubit gates: CNOT, Toffoli, Swap; Quantum circuit representation; Reversibility and no-cloning theorem; Simulation of basic quantum circuits using open-source tools (Qiskit/Cirq)

Unit III: Quantum Algorithms

Quantum parallelism and interference; Deutsch-Jozsa algorithm; Bernstein-Vazirani algorithm; Simon's algorithm; Grover's Search algorithm; Quantum Fourier Transform (QFT); Shor's factoring algorithm; Complexity classes: BQP vs P and NP

Unit IV: Quantum Error Correction and Decoherence

Quantum noise and decoherence; Introduction to quantum error correction codes; Shor code, Bit-flip and Phase-flip codes; Fault-tolerant quantum computation; Physical realizations of qubits (superconducting, ion traps, photonics); Quantum hardware limitations

Unit V: Quantum Applications in AI and Optimization

Quantum machine learning: amplitude encoding, quantum data loading; Variational Quantum Circuits

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(VQCs); Quantum Support Vector Machine (QSVM); Quantum annealing and D-Wave systems; Quantum-inspired algorithms for ML; Case studies and future trends in quantum-AI integration

Textbooks

1. Michael A. Nielsen and Isaac L. Chuang, Quantum Computation and Quantum Information, Cambridge University Press

Reference Books

1. Phillip Kaye, Raymond Laflamme, Michele Mosca, An Introduction to Quantum Computing, Oxford University Press
2. Scott Aaronson, Quantum Computing Since Democritus, Cambridge University Press
3. Chris Bernhardt, Quantum Computing for Everyone, MIT Press

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Program Elective III- Quantum Computing Lab (25UCSE04)							
B. Tech. CSE (AI/ML)							
Semester-VII							
L	T	P	Credits	Core Course	Internal Examination	:	35
0	0	2	1		External Examination	:	15
Effective from Session:				w.e.f. 2024-2025	Total	:	50
Date of BOS approval:				22-7-2024	Duration of Exam	:	3 hrs
Prerequisite							

Course Objectives:

After successful completion of the course, students will be able to:

CO1: Represent and manipulate quantum states and circuits using Qiskit or Cirq.

CO2: Simulate basic quantum logic gates and understand their operations.

CO3: Implement quantum algorithms like Deutsch-Jozsa, Grover's, and QFT.

CO4: Explore quantum measurements, entanglement, and superposition with practical examples.

CO5: Apply quantum computing to solve basic problems in optimization and machine learning.

List of Experiments:

1. Install and configure Qiskit or Cirq and simulate a basic quantum circuit with a single qubit gate (Hadamard).
2. Write a program to create and visualize superposition and measure a single qubit multiple times.
3. Simulate the Pauli-X, Y, Z gates on a qubit and display their effect on quantum state.
4. Build a quantum circuit using CNOT and Hadamard to demonstrate entanglement between two qubits.
5. Create a 2-qubit Bell state and verify entangled measurement outcomes.
6. Simulate the Deutsch-Jozsa algorithm using Qiskit for constant and balanced functions.
7. Implement Grover's algorithm for a 2-qubit system to search a marked element.
8. Simulate Quantum Fourier Transform (QFT) on a 3-qubit system and observe transformation.

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9. Demonstrate the effect of quantum measurement on superposition states with visualization.
10. Write a program to apply basic quantum gates conditionally and measure outcome probabilities.
11. Design a quantum half-adder circuit using Toffoli and CNOT gates.
12. Simulate quantum teleportation protocol and verify successful state transfer.
13. Use Qiskit's Aer simulator to compare ideal vs noisy circuit behavior.
14. Apply Variational Quantum Circuit (VQC) to classify a simple binary dataset.
15. Demonstrate quantum-inspired optimization using QAOA or a basic quantum annealing example.

Textbooks

1. Michael A. Nielsen and Isaac L. Chuang, Quantum Computation and Quantum Information, Cambridge University Press

Reference Books

2. Phillip Kaye, Raymond Laflamme, Michele Mosca, An Introduction to Quantum Computing, Oxford University Press
3. Scott Aaronson, Quantum Computing Since Democritus, Cambridge University Press
4. Chris Bernhardt, Quantum Computing for Everyone, MIT Press

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Program Elective IV-Generative AI (25UCSE05)							
B. Tech. CSE (AI/ML)							
Semester-VII							
L	T	P	Credits	Core Course	Internal Examination	:	30
3	0	0	3		External Examination	:	70
Effective from Session:				w.e.f. 2025-2026	Total	:	100
Date of BOS approval:					Duration of Exam	:	3 Hrs
Prerequisite							

Course Outcomes

After successful completion of the course, students will be able to:

CO1: Understand the core concepts and models underlying generative AI.

CO2: Explore and implement different generative models including VAEs, GANs, and transformers.

CO3: Analyze applications of generative AI in text, image, audio, and video generation.

CO4: Evaluate the creative potential of generative models across domains such as art, design, and music.

CO5: Address ethical, societal, and safety issues related to generative AI technologies.

Unit I: Introduction to Generative AI

Definition and scope of generative AI; Discriminative vs generative models; Applications in creativity: art, music, literature, gaming; Brief history and evolution of generative models; Probabilistic modeling and data distribution learning; Introduction to creativity in AI systems

Unit II: Generative Models – Fundamentals and Variational Autoencoders (VAEs)

Latent space and representation learning; Autoencoders and their limitations; Variational Autoencoders (VAEs): theory and implementation; KL divergence and reparameterization trick; Hands-on implementation of VAEs for image and text data

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Unit III: Generative Adversarial Networks (GANs)

Concept of adversarial training; Generator and discriminator networks; Loss functions and training dynamics; Variants: DCGAN, Conditional GAN, CycleGAN, StyleGAN; Challenges in GAN training: mode collapse, convergence issues; Use cases in creative content generation

Unit IV: Generative Transformers and Diffusion Models

Transformers and self-attention mechanism; Language models (GPT series), Text generation and prompt engineering; Diffusion models: denoising diffusion probabilistic models (DDPMs), Stable Diffusion; Comparison between GANs and diffusion models in creativity tasks

Unit V: Applications, Ethics, and Future of Generative AI

Generative AI in visual art, design, fashion, music, writing, game design; Case studies: DALL·E, MidJourney, ChatGPT, MuseNet, Jukebox; Legal and ethical challenges: authorship, deepfakes, bias; Open-source tools and frameworks (Hugging Face, OpenAI APIs); Future directions and interdisciplinary innovations

Textbooks

1. David Foster, *Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play*, O'Reilly Media
2. Sebastian Raschka et al., *Machine Learning with PyTorch and Scikit-Learn*, Packt Publishing (for practicals)

Reference Books

1. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, *Deep Learning*, MIT Press
2. Kevin Ashley, *Artificial Intelligence and Legal Analytics*, Cambridge University Press
3. Margaret A. Boden, *Creativity and Artificial Intelligence*, Routledge

Mark


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Program Elective III- Generative AI Lab (25UCSE06)							
B. Tech. CSE (AI/ML)							
Semester-VI							
L	T	P	Credits	Core Course	Internal Examination	:	35
0	0	2	1		External Examination	:	15
Effective from Session:				w.e.f. 2025-2026	Total	:	50
Date of BOS approval:					Duration of Exam	:	3 hrs
Prerequisite							

Course Objectives

After successful completion of the course, students will be able to:

CO1: Understand the core concepts and models underlying generative AI.

CO2: Explore and implement different generative models including VAEs, GANs, and transformers.

CO3: Analyze applications of generative AI in text, image, audio, and video generation.

CO4: Evaluate the creative potential of generative models across domains such as art, design, and music.

CO5: Evaluate the ethical, societal, and safety implications of generative AI technologies and justify responsible design and deployment practices.

List of Experiments

1. Set up Python environment and install essential libraries like PyTorch, TensorFlow, Hugging Face, and OpenAI API.
2. Load and preprocess datasets such as MNIST, CIFAR-10, or text corpora for use in generative models.
3. Train a simple autoencoder on image data and visualize the reconstructed outputs.
4. Implement a VAE and generate new samples by exploring the learned latent space.
5. Build and train a simple GAN on MNIST to generate synthetic digit images.
6. Implement a DCGAN using convolutional layers to generate improved quality images.
7. Generate images based on class labels using a Conditional GAN.
8. Perform unpaired image-to-image translation using CycleGAN (e.g., horse ↔ zebra).

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9. Generate coherent and creative text using GPT-2 or GPT-Neo with prompt inputs.
10. Design prompts for tasks like storytelling, Q&A, and creative writing using LLMs.
11. Use Stable Diffusion or similar models to generate images from textual prompts.
12. Create imaginative visual content from descriptive text prompts using DALL-E or Replicate API.
13. Generate audio or music using models like Jukebox or Riffusion and explore genre-specific samples.
14. Analyze AI-generated content and discuss originality, bias, and ethical implications.
15. Develop and demonstrate a creative generative AI application in a selected domain (art, music, writing, etc.).

Textbooks

1. David Foster, *Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play*, O'Reilly Media
2. Sebastian Raschka et al., *Machine Learning with PyTorch and Scikit-Learn*, Packt Publishing (for practicals)

Reference Books

1. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, *Deep Learning*, MIT Press
2. Kevin Ashley, *Artificial Intelligence and Legal Analytics*, Cambridge University Press
3. Margaret A. Boden, *Creativity and Artificial Intelligence*, Routledge

Howie

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Program Elective IV-Explainable AI (XAI) (25UCSE07)							
B. Tech. CSE (AI/ML)							
Semester-VII							
L	T	P	Credits	Core Course	Internal Examination	:	30
3	0	0	3		External Examination	:	70
Effective from Session:				w.e.f. 2025-2026	Total	:	100
Date of BOS approval:					Duration of Exam	:	3 Hrs
Prerequisite							

Course Outcomes

After successful completion of the course, students will be able to:

CO1: Understand the need for interpretability and transparency in AI systems.

CO2: Distinguish between black-box, gray-box, and white-box models.

CO3: Apply model-specific and model-agnostic methods to explain AI decisions.

CO4: Evaluate explainability techniques using metrics and human-centric analysis.

CO5: Design interpretable AI systems with applications in healthcare, finance, and autonomous systems.

Unit I: Introduction to Explainable AI

Need for explainability in AI; Black-box vs white-box models; Trust, fairness, and accountability in AI; Stakeholders and XAI; Legal and ethical motivations (e.g., GDPR, AI Act); Interpretability vs accuracy trade-off; Overview of XAI tools and frameworks

Unit II: Interpretable Models and Intrinsic XAI

White-box models: Decision trees, linear models, rule-based learners; Feature importance in interpretable models; Global vs local interpretability; Transparent model design and regularization; Advantages and limitations of inherently interpretable models

Unit III: Post-hoc Model-Agnostic Explanation Techniques

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LIME (Local Interpretable Model-agnostic Explanations); SHAP (SHapley Additive ExPlanations); Partial Dependence Plots (PDP); Individual Conditional Expectation (ICE); Anchors; Counterfactual explanations; Visualization and interpretation techniques

Unit IV: Explanation Techniques for Deep Learning

Gradient-based methods (Saliency Maps, Grad-CAM, Integrated Gradients); Layer-wise relevance propagation; Attention mechanisms and interpretability; Surrogate models for CNNs and RNNs; Explanation challenges in large language models (LLMs); Visualization tools for neural networks

Unit V: Applications, Evaluation, and Challenges in XAI

XAI in healthcare, finance, and autonomous systems; Human-centric evaluation of explanations (fidelity, comprehensibility, usability); Quantitative metrics for explainability; XAI in fairness and bias mitigation; Challenges and future directions in explainable and trustworthy AI

Textbooks

1. Christoph Molnar, *Interpretable Machine Learning*, Leanpub (open access)
2. Ankur Taly et al., *Practical Explainable AI using LIME and SHAP*, Packt Publishing

Reference Books

1. Sameer Singh, Marco Ribeiro, Carlos Guestrin, *Why Should I Trust You?* (Paper on LIME)
2. Been Kim et al., *Interpretability Beyond Feature Attribution: Quantitative Testing with Concept Activation Vectors (TCAV)*
3. Rajiv Shah, *Explainable AI: Interpreting, Explaining and Visualizing Deep Learning*, Springer

Maid


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Program Elective IV- Explainable AI (XAI) Lab (25UCSE08)							
B. Tech. CSE (AI/ML)							
Semester-VII							
L	T	P	Credits	Core Course	Internal Examination	:	35
0	0	2	1		External Examination	:	15
Effective from Session:				w.e.f. 2025-2026	Total	:	50
Date of BOS approval:					Duration of Exam	:	3 hrs
Prerequisite							

Course Objectives:

After successful completion of the lab course, students will be able to:

CO1: Implement interpretable models and visualize decision logic.

CO2: Apply model-agnostic techniques like LIME and SHAP for local and global explanations.

CO3: Interpret complex deep learning models using saliency-based and gradient-based techniques.

CO4: Evaluate the effectiveness of explanations using both qualitative and quantitative metrics.

CO5: Develop transparent and accountable AI applications in real-world domains.

List of Experiments

1. Build a decision tree model and visualize the decision paths for interpretability.
2. Train a logistic regression and a random forest model, and analyze feature importance.
3. Use PDP to understand global feature effects on predictions in a black-box model.
4. Visualize ICE plots for local interpretability across different input instances.
5. Use the LIME library to explain individual predictions for tabular data.
6. Generate SHAP values and summary plots for tree-based or neural network models.
7. Apply both techniques on a classifier and compare their explanation behavior.
8. Use Anchor explanations to generate high-precision if-then rules from a classifier.
9. Train a CNN and use saliency maps to visualize important input pixels.

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10. Apply Grad-CAM to highlight regions in an image that influenced CNN predictions.
11. Implement Integrated Gradients to attribute importance to input features.
12. Visualize attention weights in a transformer-based model for sequence tasks.
13. Use libraries like DiCE to generate and visualize counterfactual samples.
14. Apply evaluation metrics to judge the quality and usefulness of different explanation methods.
15. Develop an interpretable AI system (e.g., loan approval, medical diagnosis) and explain decisions using multiple XAI techniques.

Textbooks

1. Christoph Molnar, *Interpretable Machine Learning*, Leanpub (open access)
2. Ankur Taly et al., *Practical Explainable AI using LIME and SHAP*, Packt Publishing

Reference Books

1. Sameer Singh, Marco Ribeiro, Carlos Guestrin, *Why Should I Trust You?* (Paper on LIME)
2. Been Kim et al., *Interpretability Beyond Feature Attribution: Quantitative Testing with Concept Activation Vectors (TCAV)*
3. Rajiv Shah, *Explainable AI: Interpreting, Explaining and Visualizing Deep Learning*, Springer

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