Course Title:
Advanced AI/ML for Teaching, Research, and Innovation

Target Audience:
Faculty members in Computer Science, Engineering, and IT-related disciplines

Course Duration:
3 Days (7 Hours/Day) – **Total: 21 Hours**

Delivery Mode:
Blended (In-person or Online Synchronous with Hands-on Labs)

Prerequisites:

- Basic understanding of programming (preferably Python)
- Familiarity with computer science or engineering curricula
- Prior exposure to data analysis or basic ML concepts is helpful

Course Description:

This advanced course is designed for technical faculty aiming to integrate AI/ML into their teaching, research, and academic innovation practices. It offers a balanced mix of theoretical depth and practical exposure, with hands-on labs and case-based learning. Key topics include deep learning, NLP, AI ethics, curriculum enhancement using AI, and developing AI-powered academic projects.

Learning Objectives:

By the end of the course, participants will:

1. Understand AI & ML frameworks and their applications in academia and industry.
2. Apply AI methodologies in research and teaching innovation.
3. Use AI tools for curriculum development and instructional enhancement.
4. Develop and deploy AI models for real-world applications.
5. Evaluate ethical and compliance issues in AI applications.

Learning Outcomes:

Participants will be able to:

- Apply AI/ML frameworks (TensorFlow, PyTorch) to research problems.
- Create AI-driven course content and automate assessment tasks.
- Implement deep learning and NLP models for education.
- Address AI ethics and bias in academic settings.
- Design an AI-enhanced curriculum or research project.

Key Skills Gained:

- AI/ML model development & deployment

- Predictive analytics for research
- Deep learning & NLP for education
- AI ethics and policy compliance
- AI-powered instructional design
- LMS integration with AI tools

Instructional Methodology:

- Expert-led sessions with domain specialists
- Hands-on labs and toolkits (Jupyter, TensorFlow, etc.)
- Case study analysis and academic simulations
- Peer collaboration and project-based learning
- Ethical debates and policy discussions
- Final capstone project with peer review

Course Modules Overview:

Module	Title	Duration
Module 1	AI & ML Fundamentals for Technical Faculty	3 Hours
Module 2	AI for Research & Academic Innovation	3 Hours
Module 3	Deep Learning & NLP in Education	3 Hours
Module 4	AI for Teaching & Curriculum Enhancement	3 Hours
Module 5	AI Ethics, Governance & Future Trends	3 Hours
Final Capstone Project + Presentations		6 Hours

Assessment Strategy:

- Formative quizzes and coding exercises
- Peer-reviewed hands-on activities
- Final project: AI-enhanced curriculum or research design
- Feedback and reflection sessions

Advanced AI/ML for Teaching, Research, and Innovation

Duration: 3 Days | **Daily Hours:** 7 (Including breaks)

Day 1: Foundations and Research Applications

Session 1: Course Introduction & Orientation

🕘 **09:00 AM – 10:00 AM**

Objectives:

- Introduce the course structure, expectations, and delivery model
- Outline the relevance of AI/ML in academia and research
- Engage participants in reflective goal-setting
- Align learning goals with participants' teaching/research contexts
- Conduct a pre-assessment to measure entry-level understanding

Outcomes:

- Clear understanding of course learning paths and expectations
- Established individual learning objectives
- Awareness of AI/ML's impact on academic practices
- Confidence in navigating the course flow
- Identified personal learning goals

Key Skills Gained:

- Goal articulation and expectation setting
- Engagement in collaborative academic environments
- Familiarity with faculty development practices
- Pre-assessment interpretation
- Reflective goal alignment

Key Takeaways:

- Shared understanding of the course and its value
- Identified gaps in AI/ML knowledge
- Orientation to peer learning culture
- Personal baseline readiness
- Enhanced awareness of educational innovation needs

Hands-On Activities:

- Pre-course self-assessment quiz
- Peer introduction and expectation mapping
- Learning objective planning worksheet
- Warm-up discussion on AI/ML in teaching
- Concept mapping exercise on “AI in my classroom”

Case Studies:

- Overview of AI integration at select universities
- Illustrative example: Introductory course redesign using AI

Scenario-Based Discussions:

- “What if your grading system was AI-driven?”
- “How would you explain AI to a non-tech student?”
- “AI integration – barrier or opportunity?”
- “How would your students respond to AI assessments?”

Topics Covered:

- Orientation to course flow
- Pre-assessment and self-reflection
- AI/ML landscape in higher education
- Participant roles and expectations

☕ **Tea Break** – 10:00 AM to 10:15 AM

Session 2: Module 1 – AI & ML Fundamentals for Technical Faculty

🕐 **10:15 AM – 01:15 PM**

Objectives:

- Introduce foundational AI/ML concepts and algorithms
- Familiarize participants with TensorFlow and PyTorch
- Demonstrate basic model training and evaluation
- Explore use cases in higher education
- Enable participants to configure AI environments

Outcomes:

- Functional AI environment set up
- Executed simple AI models for classification/prediction
- Explained key AI/ML terminology

- Identified frameworks suitable for academic use
- Mapped basic AI concepts to teaching

Key Skills Gained:

- Environment setup using Jupyter Notebook
- Using TensorFlow and PyTorch libraries
- Data preparation for modeling
- Running and interpreting ML models
- Linking AI tools with course design

Key Takeaways:

- Confidence in running basic AI experiments
- Understanding of educationally relevant models
- Awareness of differences between AI frameworks
- Preparedness for advanced modeling tasks
- Introduction to AI-supported academic workflows

Hands-On Activities:

- Installing Jupyter Notebooks and libraries
- Training a simple image/text classification model
- Model evaluation: Accuracy, Loss
- Visualizing model performance
- Framework comparison: TensorFlow vs PyTorch

Case Studies:

- Automated grading of Python assignments
- Facial recognition for attendance systems
- Predicting lab performance using historic data

Scenario-Based Discussions:

- “Which AI framework fits your course needs?”
- “How do we introduce model training to students?”
- “What risks exist in using pretrained models in education?”
- “Can your LMS support AI plugins?”

Topics Covered:

- AI/ML definitions and types

- TensorFlow & PyTorch basics
- Supervised learning fundamentals
- Case examples in technical education

🍽 **Lunch Break** – 01:15 PM to 02:00 PM

Session 3: Module 2 – AI for Research & Academic Innovation

🕑 **02:00 PM – 04:30 PM**

Objectives:

- Demonstrate AI in academic data analysis and modeling
- Introduce tools like Scikit-learn and AutoML
- Build predictive models using educational datasets
- Explore simulation and modeling in CS/STEM research
- Link AI outputs to research innovation

Outcomes:

- Developed and tested predictive models
- Used AI to draw insights from research data
- Evaluated models based on accuracy and utility
- Created simple academic simulations
- Applied AI to domain-specific research questions

Key Skills Gained:

- Predictive analytics
- Dataset processing and visualization
- Modeling and simulation using AI
- Applying AI to scientific problems
- Interpretation of model results in research

Key Takeaways:

- AI supports dynamic and complex research workflows
- Understanding of model fit and generalization
- Tools and packages relevant for academic innovation
- AI as an accelerator for data-driven research
- Awareness of domain-specific adaptations

Hands-On Activities:

- Dataset cleaning and preparation
- Training models using Scikit-learn
- Comparing regression and classification models
- AutoML experimentation
- Using AI for simulation in computational research

Case Studies:

- Predictive dropout risk analysis
- AI for optimizing lab schedules
- Citation prediction models

Scenario-Based Discussions:

- "How can AI validate your research hypothesis?"
- "Could your department collaborate with AI startups?"
- "Are faculty ready to publish with AI tools?"
- "What if thesis evaluation used AI support?"

Topics Covered:

- AI in academic research
- Predictive modeling
- Scientific simulations using AI
- Research toolkits and automation

Reflection & Q&A — 04:30 PM – 05:00 PM

- Recap, group insights, open forum

Day 2 – Deep Learning, NLP & Educational Applications (7 Hours)

Session 4: Module 3 – Deep Learning & NLP in Education

🕘 **09:00 AM – 11:30 AM**

Objectives:

- Introduce neural networks and NLP in educational contexts
- Demonstrate the design of academic recommender systems
- Explore tools like SpaCy, NLTK, and HuggingFace
- Discuss AI's ability to interpret and generate text
- Highlight NLP's role in adaptive learning

Outcomes:

- Participants build a basic NLP model
- Create a basic recommender system for academic use
- Understand preprocessing and feature extraction
- Link deep learning to real classroom applications
- Recognize the potential of generative models in teaching

Key Skills Gained:

- Text tokenization and vectorization
- Neural network construction basics
- Implementation of NLP for feedback analysis
- Introduction to word embeddings and transformers
- Recommendation logic using AI

Key Takeaways:

- NLP helps personalize learning experiences
- Deep learning models can aid educational equity
- Importance of context in academic text processing
- NLP improves communication and assessment feedback
- Tools like GPT and BERT have transformative potential

Hands-On Activities:

- Build a sentiment classifier from student feedback
- Create a keyword extractor for curriculum tagging
- Design a mini course recommendation engine
- Experiment with transformers for text summarization
- Compare AI-generated vs human feedback

Case Studies:

- AI for sentiment analysis in course evaluations
- GPT-powered academic support bots
- BERT-based document classification in LMS systems

Scenario-Based Discussions:

- “How would AI process feedback from a low-performing class?”
- “Should AI-generated responses be disclosed to students?”

- "Could an AI assistant handle student FAQs?"
- "How would you moderate AI-written responses for bias?"

Topics Covered:

- Introduction to deep learning and neural nets
- NLP applications in education
- AI-powered recommendation systems
- Ethics of AI-generated content

☕ **Tea Break** – 11:30 AM to 11:45 AM

Session 5: Module 4 – AI for Teaching & Curriculum Enhancement

🕐 **11:45 AM – 02:15 PM**

Objectives:

- Showcase AI for adaptive learning and grading automation
- Integrate AI into LMS platforms like Moodle or Canvas
- Apply AI to content sequencing and difficulty adjustment
- Discuss pedagogical theories (Bruner, Laurillard) in AI design
- Create AI-enhanced teaching prototypes

Outcomes:

- Designed adaptive content using AI tools
- Implemented auto-grading plugins into LMS
- Modeled intelligent feedback loops for students
- Understood instructional theory and AI synergy
- Identified implementation paths for personal courses

Key Skills Gained:

- LMS plugin integration
- Automated test and quiz generation
- Adaptive sequencing based on performance
- Use of AI for course analytics
- Scaffolding curriculum using AI insights

Key Takeaways:

- AI creates personalized, data-driven experiences
- Auto-grading reduces workload and bias

- LMS integration enables continuous feedback
- Alignment with learning science enhances outcomes
- Future-ready teaching depends on tech agility

Hands-On Activities:

- Use Moodle or Open edX to embed AI tools
- Create adaptive assessments with auto-feedback
- Implement a chatbot for student engagement
- Design a micro-course with AI-powered paths
- Analyze student engagement through AI analytics

Case Studies:

- AI in formative assessments (e.g., Edmodo, Knewton)
- Bruner's spiral curriculum in adaptive LMS modules
- Laurillard's conversational model and AI dialog systems

Scenario-Based Discussions:

- "Would you trust AI to grade programming assignments?"
- "Can AI detect academic disengagement early?"
- "What AI signals would you use to adjust teaching pace?"
- "How to communicate AI use to your students?"

Topics Covered:

- AI-assisted instruction and feedback
- Personalized learning via AI
- Grading automation and fairness
- Instructional design meets AI

🍽 **Lunch Break** – 02:15 PM to 03:00 PM

Reflection & Peer Review

🕒 **03:00 PM – 05:00 PM**

Objectives:

- Allow peer critique of initial AI-enhanced ideas
- Reflect on design decisions and teaching transformation
- Develop cross-course collaboration insights
- Build community for post-course innovation

- Refine ideas for capstone preparation

Activities:

- Small group presentations of prototype tools
- Peer review rubric discussions
- Instructor feedback for improvements
- Cross-topic comparison
- Strategic planning for final project

Day 3 – Ethics, Future Trends, and Capstone (7 Hours)

Session 6: Module 5 – AI Ethics, Governance & Future Trends

🕘 **09:00 AM – 11:30 AM**

Objectives:

- Explore ethics of bias, fairness, and transparency in AI
- Introduce regulatory frameworks (GDPR, IEEE)
- Examine consequences of misused AI in education
- Study decolonial and critical approaches to AI
- Identify trends shaping AI's future in academia

Outcomes:

- Participants assess bias in AI models and decisions
- Drafted AI ethics and compliance checklist
- Analyzed real-world AI failures in academic settings
- Connected equity principles to algorithm design
- Explored scalable governance models

Key Skills Gained:

- Bias detection and mitigation in academic AI
- Designing ethics rubrics for project approval
- Understanding legal implications in AI deployment
- Critical AI literacy
- Awareness of equity-centered design

Key Takeaways:

- AI ethics is not optional — it's foundational

- Fairness ≠ equal treatment — it means equitable treatment
- Compliance must be contextual and intentional
- Inclusion must be built into data and design
- Ethical AI requires multi-disciplinary collaboration

Hands-On Activities:

- Analyze a biased model from an academic context
- Create a checklist for AI ethical review in course planning
- Draft policies for LMS-based AI tools
- Simulate an ethical audit of an academic AI project
- Review GDPR-aligned AI consent practices

Case Studies:

- Cathy O'Neil's *Weapons of Math Destruction*
- Ruha Benjamin's critique of algorithmic injustice
- Proctoring software bias against darker skin tones
- AI misidentification in college admissions

Scenario-Based Discussions:

- "Who is responsible when AI makes a harmful decision?"
- "How transparent should AI grading systems be to students?"
- "Can algorithmic fairness be audited by faculty?"
- "Should institutions require an AI ethics board?"

Topics Covered:

- AI bias, discrimination, and fairness
- Governance and regulation (GDPR, IEEE, campus policies)
- Future of AI in education
- Critical pedagogy and algorithmic justice

☕ **Tea Break** – 11:30 AM to 11:45 AM

Session 7: Capstone Project Development & Presentation

🕐 **11:45 AM – 04:30 PM** *(includes lunch)*

Objectives:

- Synthesize all learning into a research or course innovation
- Apply tools, frameworks, and ethical thinking into a final product

- Receive mentor and peer guidance
- Present and review innovations
- Plan next steps for institutional implementation

Outcomes:

- A completed AI-enhanced curriculum module or research prototype
- Applied ethical frameworks in project decisions
- Presented to peers and instructors for critique
- Identified roadmap for deployment at institution
- Built confidence for academic leadership in AI

Key Skills Gained:

- Educational AI design thinking
- Cross-functional implementation planning
- Innovation communication and feedback management
- Alignment of tech with pedagogy and ethics
- Long-term project visioning

Key Takeaways:

- AI can powerfully support academic excellence
- Good design = ethical, inclusive, effective
- Implementation success requires local leadership
- Collaboration amplifies innovation
- Faculty are catalysts for responsible AI adoption

Hands-On Activities:

- Finalize capstone with peer feedback
- Presentation preparation (pitch or demonstration)
- Feedback cycles with rubrics
- Final review of tools and frameworks used
- Upload project to institutional knowledge base

Scenario-Based Discussions:

- “What could go wrong with your AI design?”
- “How will you support your department in AI adoption?”
- “What policies will you need to succeed?”

- "How do you measure student impact?"

Topics Covered:

- Capstone synthesis of teaching/research AI
- Project presentations
- Post-course implementation planning
- Faculty leadership in AI innovation

🍽 **Lunch Break** — 01:30 PM – 02:15 PM *(within Capstone session)*

Final Presentations & Course Wrap-Up

🕓 **04:30 PM – 05:00 PM**

Activities:

- Capstone demos and idea showcases
- Peer and instructor recognition
- Post-assessment and certificate ceremony
- Final reflection roundtable
- Group photo and alumni network invitation