University of Global Village (UGV), Barishal

Content of the Theory Course
University Student (UGV) Format

Program: Bachelor of Science in Computer Science Engineering (CSE)

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Course Code	CSE-405
Name of Course Title	Artificial Intelligence
Course Type	Core Course
Level	7th Semester
Academic Session	Summer 2024
Name(s) of AcademicCourse teacher(s)	Md. Jubayar Alam Rafi. Lecturer, CSE. Mobile: 01707587089 E-mail: jobayaralamrafi27093@gmail.com
Consultation Hours:	

Artificial Intelligence Student (UGV) Format	
Course Code: CSE-405	Credits: 03
Exam Hours: 03	CIE Marks: 90
Course for 7th Semester, Bachelor of Science in Computer Science Engineering (CSE)	SEE Marks: 60

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1. Rationale for the inclusion of the program

Rationale for the inclusion of the course/module in the program	AI's explosion in electrical and electronic engineering demands a curriculum update. Including AI equips students with the tools to tackle complex problems using machine learning and optimize processes with intelligent automation. This empowers them to design AI-powered tools that create innovative solutions and explore vast design spaces. Beyond technical skills, AI fosters critical thinking and data analysis – essential for the modern engineering workplace. Incorporating AI isn't optional, but a necessity to prepare future engineers for success.
Pre-requisite (if any)	Machine Learning
Status	One of the core courses of CSE
Credit Value (hours)	3 (3 hours)
Total Marks	150

2. Course Summary:

1.	**Introduction to Artificial Intelligence:**	- Definition and history of AI - Basic concepts and goals of AI -Applications and impact of AI in various fields

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2.	**Problem-Solving and Search Algorithms:**	- Problem-solving methods in AI - Search algorithms: breadth-first search, depth-first search, A* search, etc. - Heuristic search techniques
3.	**Knowledge Representation and Reasoning:**	- Representing knowledge in AI systems - Propositional and predicate logic - Inference rules and reasoning techniques
4.	**Machine Learning Fundamentals:**	- Introduction to machine learning - Supervised learning, unsupervised learning, and reinforcement learning - Evaluation metrics in machine learning
5.	**Regression and Classification Algorithms:**	- Linear regression - Logistic regression - Decision trees and random forests - Support Vector Machines (SVM) - Naive Bayes classifier

6.	**Clustering and Dimensionality Reduction:**	- K-means clustering - Hierarchical clustering - Principal Component Analysis (PCA) - t-Distributed Stochastic Neighbor Embedding (t-SNE)
7.	**Neural Networks and Deep Learning:**	- Introduction to neural networks - Feedforward neural networks - Convolutional Neural Networks (CNNs) - Recurrent Neural Networks (RNNs) - Training deep learning models
8.	**Natural Language Processing (NLP):**	- Introduction to NLP - Text preprocessing techniques - Sentiment analysis - Named Entity Recognition (NER) - Text generation

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9.	**Reinforcement Learning:**	- Introduction to reinforcement learning - Markov Decision Processes (MDPs) - Q-learning & Deep Q-Networks (DQN) - Policy Gradient methods
10.	**Applications of AI and Machine Learning:**	- Real-world applications in various domains such as healthcare, finance, robotics, autonomous vehicles, etc. - Ethical considerations and societal impact of AI
11.	**Hands-on Projects and Practical Implementation:**	- Implementation of machine learning algorithms using libraries such as TensorFlow, PyTorch, scikit-learn, etc. - Hands-on projects to apply AI and ML techniques to real-world datasets
12.	**Advanced Topics (Optional):**	- Generative Adversarial Networks (GANs) - Transfer learning - Reinforcement learning in robotics - Time series analysis - Bayesian methods

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3. Course Objectives:

Upon completing this Artificial Intelligence course, students will be able to:

i. Understand and explain the fundamental concepts and applications of AI in engineering

- Grasp the core principles of artificial intelligence, including its history, development, and key components such as machine learning,
  neural networks, and natural language processing.
- Explore the various applications of AI in different branches of engineering, such as mechanical, electrical, civil, and software engineering.
- Discuss case studies and examples where AI has been successfully implemented to solve engineering challenges and improve efficiency.

ii. Apply machine learning algorithms to solve real-world engineering problems

- Learn about different types of machines learning algorithms, including supervised, unsupervised, and reinforcement learning.
- Gain hands-on experience with popular machine learning frameworks and tools such as TensorFlow, PyTorch, and scikit-learn.
- Develop skills to preprocess and clean data, select appropriate algorithms, train models, and evaluate their performance on real-world datasets.
- Work on practical projects that involve applying machine learning to address specific engineering problems, such as predictive maintenance, quality control, and optimization.

iii. Implement AI techniques in the design and optimization of systems

- Understand the role of AI in the design and optimization of complex engineering systems, including control systems, manufacturing processes, and infrastructure management.
- Learn about optimization techniques such as genetic algorithms, simulated annealing, and particle swarm optimization, and how they can be integrated with AI.
- Design and implement AI-driven solutions to enhance system performance, reduce costs, and improve reliability.

iv. Analyze and interpret data using AI tools

- Acquire skills in data analysis and visualization using AI tools and software, such as MATLAB, R, and Python.
- Learn techniques for extracting meaningful insights from large and complex datasets, including feature selection, dimensionality reduction, and clustering.
- Develop the ability to interpret the results of AI models and communicate findings effectively to both technical and non-technical audiences.
- Apply statistical and AI-based methods to solve data-driven engineering problems, such as fault detection, anomaly detection, and predictive analytics.

v. Evaluate the ethical implications and societal impact of AI technologies

- Explore the ethical considerations surrounding the use of AI, including issues related to privacy, bias, transparency, and accountability.
- Discuss the potential societal impacts of AI, such as job displacement, economic inequality, and changes in social dynamics.
- Examine regulatory frameworks and guidelines for the responsible development and deployment of AI technologies.
- Reflect on the role of engineers in ensuring that AI technologies are used for the benefit of society and adhere to ethical standards.

4. Course Learning Outcome (CLO) at the end of the course, the students will be able to-

CLO1	**Understand the Fundamental Concepts and Theories of Artificial Intelligence**
	➢ **History and Evolution:** Trace the history of AI from its inception to current advancements. ➢ **Key Concepts:** Understand key AI concepts such as machine learning, neural networks, natural language processing, and robotics. ➢ **Mathematical Foundations:** Grasp the mathematical principles underlying AI algorithms, including linear algebra, probability, and statistics. ➢ **AI Ethics:** Recognize the ethical considerations and societal implications of AI technologies.
CLO2	**Apply Machine Learning Algorithms to Solve Real-World Problems**
	➢ **Supervised Learning:** Implement supervised learning algorithms such as linear regression, logistic regression, decision trees, and support vector machines. ➢ **Unsupervised Learning:** Apply unsupervised learning techniques like k-means clustering, hierarchical clustering, and principal component analysis. ➢ **Reinforcement Learning:** Understand the basics of reinforcement learning and implement simple algorithms. ➢ **Model Evaluation:** Evaluate and fine-tune machine learning models using metrics such as accuracy, precision, recall, and F1-score.
CLO3	**Develop and Implement AI Models Using Python and Relevant Libraries**
	➢ **Python Programming:** Use Python for AI development, focusing on libraries such as NumPy, pandas, scikit-learn, TensorFlow, and PyTorch. ➢ **Data Preprocessing:** Perform data cleaning, normalization, and transformation to prepare datasets for AI models. ➢ **Model Training and Testing:** Train AI models using training data and evaluate their performance on test data. ➢ **Hyperparameter Tuning:** Optimize model performance by adjusting hyperparameters and using techniques such as

	grid search and random search.
CLO4	**Design and Optimize Systems Using AI Techniques** ➢ **Optimization Algorithms:** Implement optimization techniques such as genetic algorithms, simulated annealing, and particle swarm optimization. ➢ **System Design:** Apply AI in the design of systems, enhancing efficiency, reliability, and sustainability. ➢ **Simulation and Testing:** Use simulation tools to test AI-driven designs and validate their effectiveness. ➢ **Real-Time Systems:** Develop AI solutions for real-time system optimization and control.
CLO5	**Analyze and Interpret Data Using AI Tools** ➢ **Data Visualization:** Create data visualizations to explore and present data insights using libraries like Matplotlib and Seaborn. ➢ **Exploratory Data Analysis (EDA):** Conduct EDA to uncover patterns, anomalies, and relationships within datasets. ➢ **AI in Big Data:** Understand the application of AI techniques in handling and analyzing big data. ➢ **Interpretability:** Develop skills to interpret and explain AI model predictions to stakeholders.
CLO6	**Evaluate and Address the Ethical Implications and Societal Impact of AI** ➢ **Bias and Fairness:** Identify and mitigate bias in AI models to ensure fairness and equity. ➢ **Privacy and Security:** Address privacy concerns and ensure the security of AI systems. ➢ **Regulatory Compliance:** Understand and comply with regulations and standards governing AI. ➢ **Impact Assessment:** Assess the broader societal impacts of AI technologies, including job displacement and economic implications.

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CLO7	**Explore Advanced AI Topics and Emerging Trends**
	➢ **Deep Learning:** Dive into advanced topics in deep learning, including convolutional neural networks (CNNs), recurrent neural networks (RNNs), and transformers. ➢ **Natural Language Processing (NLP):** Implement NLP techniques for tasks such as sentiment analysis, language translation, and text generation. ➢ **Computer Vision:** Apply AI to computer vision tasks such as image classification, object detection, and facial recognition. ➢ **AI in Robotics:** Explore the integration of AI in robotics for autonomous navigation, manipulation, and human-robot interaction. ➢ **AI in Industry:** Investigate the application of AI in various industries, including healthcare, finance, manufacturing, and transportation. ➢ **Research and Development:** Stay updated with the latest AI research and contribute to the development of innovative AI solutions.

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5. Mapping of Course Learning Outcomes to Program Learning Outcomes

PLOs/CLOs	CLO1	CLO2	CLO3	CLO4	CLO5	CLO6	CLO7
PLO1	3	3	2	3	3	2	3
PLO2		3	3	3	3	3	3
PLO3				3			3
PLO4				3			3
PLO5				3			

6. Topics to be covered/Content of the course

Sl no	Date	Week no	Class no	Topics	Specific Outcomes	Teaching Learning Strategy(s)	Assessment Strategy(s)	Alignment to CLO
1	1/7/24 to 7/7/24	1	1,2,3	Introduction to AI	**Describe AI concepts, history, and applications.** - Understand the fundamental concepts of AI, including its definition and key areas. - Explore the history and evolution of AI from early developments to modern advancements. - Identify various applications of AI across different industries.	Lecture, multimedia, group discussion, interactive sessions	Feedback, Q&A, assessment of LOs	CLO 1

| 2 | 8/7 - 14/7 | 2 | 4,5& 6 | Machine Learning Overview | **Explain supervised, unsupervised, and reinforcement learning.**

- Define and differentiate between supervised, unsupervised, and reinforcement learning.

- Understand the typical workflows and algorithms used in each type of machine learning.

- Discuss real-world applications and case studies for each type of learning. | Lecture, multimedia, practical examples, simulations | Feedback, Q&A, quizzes | CLO 2 |
| 3 | 15/7 - 21/7 | 3 | 7,8,& 9 | Regression and Classification | **Apply regression and classification algorithms.**

- Implement linear regression for predictive modeling.

- Apply logistic regression for binary classification problems.

- Explore decision trees and support vector machines for classification tasks. | Lecture, multimedia, hands-on practice, case studies | Midterm Quiz #1, assessment of LOs | CLO 2 |

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| 4 | 22/7 - 28/7 | 4 | 10,11 & 12 | Clustering and Neural Networks | **Explain and apply clustering techniques and neural networks.**

- Understand k-means and hierarchical clustering algorithms.

- Learn the basics of neural networks, including the structure of neurons and layers.

- Implement simple neural network models using frameworks like TensorFlow or PyTorch. | Lecture, multimedia, interactive sessions, group work | Feedback, Q&A, assessment of LOs | CLO 2 |
| 5 | 29/7 - 4/8 | 5 | 13,14 & 15 | Knowledge Representation | **Discuss logical agents and reasoning techniques.**

- Explore methods for representing knowledge in AI systems, including semantic networks and frames.

- Understand the role of logical agents in AI and how they use reasoning techniques to make decisions.

- Apply reasoning techniques such as forward and backward chaining. | Lecture, multimedia, problem-solving sessions, simulations | Midterm Case Study #1, Home Assignment #1 | CLO 3 |

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| 6 | 5/8 - 11/8 | 6 | 16,17 & 18 | Search Algorithms and Optimization | **Implement search algorithms and optimization techniques.**

- Learn about search algorithms such as breadth-first search (BFS) and depth-first search (DFS).

- Understand heuristic search techniques, including A* and greedy search algorithms.

- Implement optimization techniques like genetic algorithms and simulated annealing. | Lecture, multimedia, interactive sessions, hands-on practice | Feedback, Q&A, quizzes, group discussions | CLO 4 |
| 7 | 12/8 - 18/8 | 7 | 19,20 & 21 | Natural Language Processing (NLP) | **Develop basic NLP applications and understand text processing.**

- Learn about text preprocessing techniques such as tokenization, stemming, and lemmatization.

- Understand language models and their applications in tasks like text generation and classification.

- Implement basic NLP applications using libraries such as NLTK and spaCy. | Lecture, multimedia, practical examples, simulations | Feedback, Q&A, group discussions, assessment of LOs | CLO 5 |

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8	19/8 - 25/8	8	22,23 &24	Sentiment Analysis and Machine Translation	**Explain and implement sentiment analysis and machine translation.** - Develop sentiment analysis models to classify text based on sentiment (positive, negative, neutral). - Understand the principles of machine translation and implement simple translation systems. - Use pre-trained models and APIs for sentiment analysis and translation tasks.	Lecture, multimedia, practical examples, group work	Feedback, Q&A, quizzes, assessment of LOs	CLO 5
9	**27/8 – 13/9**	**9 & 10**		**Mid-Semester Examination**	**Mid-Semester Examination**	**Mid-Semester Examination**	**Mid-Semester Examination**	

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| 10 | 14/9 - 20/9 | 11 | 25,26 &27 | Fundamentals of Robotics and AI | **Describe the fundamentals of robotics and the role of AI in robotics.**

- Explore the basic components and functions of robotic systems.

- Understand how AI enhances robotic capabilities, including perception and decision-making.

- Discuss real-world applications of AI in robotics, such as autonomous vehicles and industrial robots. | Lecture, multimedia, interactive sessions, hands-on practice | Feedback, Q&A, group discussions, quizzes | CLO 6 |
| 11 | 21/9 - 27/9 | 12 | 28,29 &30 | Robot Perception and Motion Planning | **Explain robot perception and implement motion planning algorithms.**

- Learn about sensors and perception techniques used in robotics for object detection and navigation.

- Implement motion planning algorithms such as Dijkstra's algorithm and RRT (Rapidly-exploring Random Tree). | Lecture, multimedia, problem-solving sessions, simulations | Midterm Case Study #2, Home Assignment #2 | CLO 6 |

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					- Develop simple robotic simulations to test perception and motion planning capabilities.			
12	28/9 - 4/9	13	31,32 &33	AI in IoT and Smart Systems	**Discuss the application of AI in IoT and smart systems.** - Understand the integration of AI with IoT to create intelligent systems. - Explore use cases of AI in smart homes, cities, and industries. - Discuss the challenges and future trends in AI-powered IoT systems.	Lecture, multimedia, interactive sessions, case studies	Feedback, Q&A, group discussions, quizzes	CLO 7
13	5/9 - 11/9	14	34,35 &36	Advanced AI Topics	**Discuss advanced AI topics and current research trends.** - Explore cutting-edge AI topics such as deep reinforcement learning, GANs, and explainable AI. - Discuss recent research papers and advancements in AI technology.	Lecture, multimedia, interactive sessions, guest lectures	Feedback, Q&A, assessment of LOs	CLO 7

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					- Understand the ethical implications and societal impact of advanced AI systems.			
1 4	12/9 - 18/9	15	37,38 &39	Course Review and Project Discussions	**Review course content and discuss final projects.** - Summarize the key concepts and techniques covered throughout the course. - Provide guidance and feedback on final project development and presentation. - Encourage peer discussions and collaborative learning for project improvement.	Lecture, multimedia, project presentations, interactive discussions	Feedback, Q&A, project assessments	All CLOs
1 5	19/9 - 25/9	16	40,41 & 42	Final Project Presentations	**Present and evaluate final projects.** - Present final projects showcasing the application of AI techniques learned during the course.	Project presentations, group discussions, peer evaluations	Final Project Evaluations, feedback	All CLOs

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				- Reflect on the learning journey and identify areas for further improvement and research.			
1 6	1/10-20/10	17 & 18		**Final-Semester Examinatio n**	**Final-Semester Examination**	**Final-Semester Examination**	**Final-Semester Examinatio n**	

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7. ASSESSMENT PATTERN

Quizzes: Altogether 4 quizzes may be taken during the semester, 2 quizzes will be taken for midterm and 2 quizzes will be taken for final term. Out of these 2 quizzes for each term, average of best 2 quizzes will be counted. No makeup quizzes will be taken. Students are stronglyrecommended not to miss any quizzes

Assignments: Altogether 4 assignments may be taken during the semester, 2 assignments will be taken for midterm and 2 assignments will be taken for final term. Out of these 2 assignments for each term, average of best 2 assignments will be counted. The students will be given assignment during the class which they have to prepare at home and will submit on or before the due date. No late submission of assignment will be accepted

Presentation: The students will have to form a group of maximum 4 members. The topic of the presentation will be given to each group andstudents will have to do the group presentation on the given topic.

Classroom Participation: All the students are encouraged to come to class prepared, take part in the classroom discussion, make thoughtfulcontribution, and participate actively in all classroom activities

8. **CIE- Continuous Internal Evaluation (90 Marks)**

Bloom's Category Marks (out of 90)	Tests (45)	Assignments (15)	Quizzes (15)	Attendance (15)
Remember	5	03		
Understand	5	04	05	
Apply	15	05	05	
Analyze	10			
Evaluate	5	03	05	
Create	5			

9. **SEE- Semester End Examination (60 Marks)**

Bloom's Category	Test
Remember	7
Understand	7
Apply	20
Analyze	15
Evaluate	6
Create	5

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10. Textbooks and other resources

Category	Details
Conducted Textbook	**"Artificial Intelligence: A Modern Approach" by Stuart Russell and Peter Norvig**
Reference Books	**"Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville** **"Machine Learning: A Probabilistic Perspective" by Kevin P. Murphy**
Other Resources:	**Online Tutorials, YouTube, Simulation video, Animation video, etc.** **https://www.coursera.org/learn/machine-learning** **https://www.edx.org/course/cs50s-introduction-to-artificial-intelligence-with-python** **https://www.udacity.com/course/intro-to-artificial-intelligence--cs271** **https://youtube.com/playlist?list=PLncy2sD7w4YrJTxgIEZ_GN6Ja9Wp8iLgj&si=bXpq795Cy_Zx0Wd-**