SEMESTER S8

ADVANCED VEHICLE TECHNOLOGY

Course Code	PEAUT865	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	5/3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To understand and apply various Artificial Intelligence techniques in automotive systems, including machine learning, deep learning, and reinforcement learning, to enhance vehicle functionalities such as traffic sign recognition, driver assistance, and structural design improvements.
2. To explore the integration of AI and machine learning in electric vehicles for optimizing battery management, energy usage, and powertrain efficiency, as well as for enhancing regenerative braking systems and charging infrastructure.
3. To evaluate and implement AI-driven solutions in autonomous vehicles and vehicle maintenance, including predictive maintenance.

KTUSPECIAL

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Artificial Intelligence in Automotive Applications** Types of AI Used in Vehicles: Machine Learning, Deep Learning. Benefits, Challenges and Ethical Considerations Machine Learning Algorithms for Automotive Systems - Supervised Learning- Algorithms: Regression, Classification, Neural Networks, and Applications in Vehicle Systems: Traffic Sign Recognition, Driver Assistance. Unsupervised Learning - Algorithms: Clustering, Dimensionality Reduction, Applications: Anomaly Detection,	9

	Feature Extraction. Reinforcement Learning - Principles of Reinforcement Learning Using AI for Structural and Aesthetic Design Improvements, AI-Driven Simulation Techniques for Performance Evaluation Robotics and Automation Enhanced by AI.	
2	**AI and ML in Electric Vehicles** AI for Battery Management: Battery Health Monitoring: Using AI to Track Battery Performance and Predict Failures. Energy Management: AI Techniques for Optimizing Battery Usage and Charging. AI in EV Powertrain Optimization: Motor Control: AI for Enhancing Electric Motor Efficiency and Performance. Regenerative Braking: AI for Maximizing Energy Recovery. Charging Infrastructure and Optimization: Smart Charging Systems: AI for Efficient Charging Scheduling and Load Management. Charging Network Optimization: AI for Planning and Managing EV Charging Stations. Examples of AI Implementations.	**9**
3	**Autonomous Vehicles** Introduction to Autonomous Vehicles, Definition and Levels of Automation, Overview of Automation Levels (SAE Levels 0-5), Key Components and working principles. Data Processing and Decision Making, Software and Hardware Architecture, Safety and Cyber security Considerations, Leading Companies, and their Innovations	**9**
4	**AI in Vehicle Maintenance and Diagnostics** Predictive Maintenance - AI Techniques for Predicting Failures: Using Data Analytics to Forecast Vehicle Maintenance Needs. Condition-Based Monitoring: AI for Monitoring Vehicle Health in Real-Time. AI for Diagnostic Systems - Onboard Diagnostics: AI-Enhanced Diagnostics for Identifying and Resolving Issues. Remote Diagnostics: Using AI for Diagnosing Problems from a Distance. AI in Repair and Service - Automated Service Recommendations: AI for Providing Maintenance and Repair Suggestions, Service Automation: AI in Automating Diagnostic and Repair Processes. Examples of AI-Driven Maintenance and Diagnostics	**9**

KTU SPECIAL

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Internal Ex	Evaluate	Analyse	Total
5	15	10	10	40

Assignment: 20 Marks

Students should evaluate and analyze a real-world optimization problem, assess the proposed solutions, provide a conclusion on which solution is most appropriate for the problem, and implement the chosen solution using any specific technique/tool/software/programme.

Criteria for evaluation:

1. ***Problem Definition (K4 - 4 points)***

a. *Clearly defines the real-world optimization problem.*

b. *Examine and identifies relevant contextual factors (constraints, resources, objectives).*

2. ***Problem Analysis (K4 - 4 points)***

a. *Break-down and presents a well-reasoned solution approach.*

b. *Compare and justify the proposed solutions with evidence and logical reasoning.*

3. ***Evaluate (K5 - 4 points)***

a. *Thoroughly evaluate the proposed solutions.*

b. *Compares trade-offs, advantages, and disadvantages.*

c. *Considers feasibility, scalability, and practical implications.*

4. ***Implementation (K5 - 4 points)***

a. *Select the most feasible solution by implementing the proposed solutions/techniques.*

b. *Successfully translates the problem to solution using proposed technique.*

c. *Demonstrates proficiency in solution practices (readability, efficiency, error handling).*

5. ***Conclusion (K4- 2 points, K5 – 2 points)***

a. *Summarizes findings and insights. State which solution is most appropriate for the problem.* ***(K4)***

b. *Reflects critical thinking and informed decision-making.* ***(K5)***

Scoring:

1. ***Accomplished (4 points)****: Exceptional analysis, clear implementation, and depth of understanding.*
2. ***Competent (3 points)****: Solid performance with minor areas for improvement.*
3. ***Developing (2 points)****: Adequate effort but lacks depth or clarity.*
4. ***Minimal (1 point)****: Incomplete or significantly flawed.*

KTU SPECIAL

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 =24marks)**	• 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 sub divisions. **(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	Understand the various types of AI, including machine learning, deep learning, and reinforcement learning, and their applications in automotive systems	**K2**
CO2	Apply AI techniques to optimize battery management and powertrain performance in electric vehicles, including energy management and regenerative braking systems.	**K3**
CO3	Analyse the software and hardware architecture of autonomous vehicles, evaluating how data processing and decision-making frameworks contribute to various levels of automation and addressing safety and cyber security considerations.	**K4**
CO4	Understand AI-driven diagnostic systems and their applications in vehicle maintenance, including on board diagnostics and remote diagnostic techniques.	**K2**

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

KTU SPECIAL

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	2	3	-	-					
CO2	3	3	3	3	3	-	-					
CO3	3	2	3	2	3	-	-					
CO4	2	2	2	2	2	3	3					

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 for Autonomous Vehicles	Rajeev Agrawal	Springer	1st Edition, 2022
2	Machine Learning for Vehicle Systems: From Concept to Application	Ehsan Elahi	Wiley	1st Edition, 2023
3	Artificial Intelligence in Electric Vehicles	Tarek S. Sobh	CRC Press	1st Edition, 2021

KTU SPECIAL

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Artificial Intelligence in Transportation Systems: Design, Analysis, and Optimization	Shuo Wang and David M. Rodriguez	Springer	1st Edition, 2022
2	Autonomous Vehicles: Opportunities, Strategies, and Disruptions.	Steven E. Shladover	Elsevier	2014
3	Autonomous Vehicles: Opportunities, Strategies, and Threats	K. W. Lee, S. S. Kim, and J. H. Park	Academic Press	1st Edition, 2020
4	Automotive Safety: Anatomy, Injury, Testing, and Regulation	Jeffrey A. Pike and Matthew Reed	SAE International	2020

Video Links	
	Link ID
	Fundamentals of Electric vehicles: Technology & Economics By Prof. Ashok Jhunjhunwala, Prof. Kaushal Jha, Prof. L Kannan, Prof. Prabhjot Kaur | IIT Madras: - https://onlinecourses.nptel.ac.in/noc20_ee99/preview Introduction to Machine Learning, By Prof. Sudeshna Sarkar | IIT Kharagpur: - https://onlinecourses.nptel.ac.in/noc22_cs97/preview

KTU SPECIAL