RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

New Scheme Based On AICTE Flexible Curricula

Robotics and Artificial Intelligence, VIII Semester

RA 801 - Intelligence Drone Computing

Course Objectives:

1. To introduce the fundamentals of drones and their architecture for computing and intelligence applications.
2. To develop an understanding of sensor integration and data acquisition using drones.
3. To explore onboard and edge computing techniques for real-time drone data processing.
4. To enable students to learn path planning, autonomous navigation, and control in drones.
5. To introduce emerging applications and ethical considerations of intelligent drones in various sectors.

Course Outcomes:

After completing this course, students will be able to:

CO1: Explain drone architecture, components, and communication systems for intelligent applications.
CO2: Integrate sensors with drones for data collection and environment monitoring.
CO3: Apply onboard and edge computing techniques for real-time data processing on drones.
CO4: Implement path planning and autonomous navigation techniques in drones.
CO5: Analyze use cases and ethical considerations in intelligent drone deployment.

Syllabus

Unit 1: Introduction to Drones and Architecture
Types of drones, drone components, flight controllers, communication modules, applications of drones in surveillance and monitoring
Unit 2: Sensors and Data Acquisition in Drones
Integration of GPS, IMU, camera, LiDAR, sensor data fusion, telemetry systems, environmental monitoring
Unit 3: Edge and Onboard Computing in Drones
Onboard processing units, low-power computing, data compression, edge AI for drones, TensorFlowLite on drones
Unit 4: Path Planning and Autonomous Navigation
Path planning algorithms, obstacle avoidance, SLAM for drones, waypoint navigation, control strategies
Unit 5: Applications and Ethical Considerations
Intelligent drone applications in agriculture, delivery, disaster management, privacy and safety concerns, regulatory aspects

Text Books:

1. K.S. Natarajan, *Introduction to UAV Systems*, Wiley India.
2. Paul G. Fahlstrom, Thomas J. Gleason, *Introduction to UAV Systems*, Wiley.
3. Ty Audronis, *Getting Started with Drones: Build and Customize Your Own Quadcopter*, Maker Media.

Reference Books:

1. Shuo Yang, Jindong Tan, *Intelligent Control and Automation for Autonomous Drones*, Springer.
2. Pedro P. C. Junior, *UAV Networks and Communications*, Cambridge University Press.
3. AnisKoubaa, *Drones in Smart Cities: Security and Performance*, Springer.

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

New Scheme Based On AICTE Flexible Curricula

Robotics and Artificial Intelligence, VIII Semester

802(A) Robotics in Healthcare

Course Objectives:

1. To introduce the role and evolution of robotics in healthcare applications.
2. To study the design and functioning of medical robots used in surgery, rehabilitation, and patient care.
3. To develop understanding of sensors and actuators used in medical robotics.
4. To explore control strategies and safety considerations for healthcare robotics.
5. To examine current trends, challenges, and ethical considerations in healthcare robotics.

Course Outcomes:

After completing this course, students will be able to:
CO1: Explain the fundamentals and importance of robotics in healthcare.
CO2: Describe the working and design considerations of medical robots for various healthcare applications.
CO3: Identify and select appropriate sensors and actuators for healthcare robotic systems.
CO4: Apply control strategies ensuring safety and precision in healthcare robotics.
CO5: Analyze emerging trends, challenges, and ethical issues related to robotics in healthcare.

Syllabus:
Unit 1: Introduction to Robotics in Healthcare – evolution and applications, advantages and limitations, types of healthcare robots, robotic assistance in patient care, telemedicine using robotics.
Unit 2: Medical Robots – surgical robots, rehabilitation robots, robotic prosthetics, robotic exoskeletons, assistive robots in elderly care.
Unit 3: Sensors and Actuators in Medical Robotics – force and tactile sensors, position sensors, biomedical signal sensors, actuators used in medical robots, safety mechanisms.
Unit 4: Control Strategies and Human-Robot Interaction – control methods for precise movements, teleoperation, autonomous navigation in hospital environments, human-robot collaboration in healthcare.
Unit 5: Trends and Ethical Considerations – AI integration in healthcare robotics, remote monitoring robots, challenges in adoption, privacy and ethical issues, future of robotics in personalized healthcare.

Text Books:

1. M. Tavakoli, R. Patel, M. Moallem, *Medical Robotics: Minimally Invasive Surgery*, Wiley.
2. Paula Gomes, *Mechatronics in Medicine: A Biomedical Engineering Approach*, McGraw-Hill.

Reference Books:

1. Jacob Rosen, Blake Hannaford, Richard M. Satava, *Surgical Robotics: Systems, Applications, and Visions*, Springer.
2. Farshid Arman, *Robotics for Healthcare: Technologies, Applications, and Challenges*, CRC Press.
3. K.S. Fu, R.C. Gonzalez, C.S.G. Lee, *Robotics: Control, Sensing, Vision, and Intelligence*, McGraw-Hill (selected chapters for healthcare context).

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

New Scheme Based On AICTE Flexible Curricula

Robotics and Artificial Intelligence, VIII Semester

802(B) AI in Autonomous Vehicles

Course Objectives:

1. To introduce the role of Artificial Intelligence in autonomous vehicle systems.
2. To develop an understanding of perception, localization, and path planning in autonomous avigation.
3. To familiarize students with sensor technologies and data fusion techniques in autonomous vehicles.
4. To provide knowledge of machine learning and deep learning applications for vehicle control and decision-making.
5. To expose students to current challenges and ethical issues in the deployment of AI for autonomous driving.

Course Outcomes:
After completing this course, students will be able to:
CO1: Explain the fundamentals and significance of AI in autonomous vehicle systems.
CO2: Describe perception systems, sensor technologies, and data fusion methods used in autonomous navigation.
CO3: Apply localization and path planning techniques for autonomous vehicle navigation.
CO4: Utilize machine learning and deep learning methods for decision-making and control in autonomous vehicles.
CO5: Analyze current challenges, safety, and ethical considerations in AI-powered autonomous driving.

Syllabus:
Unit 1: Introduction to Autonomous Vehicles
Autonomous vehicle overview, levels of autonomy, role of AI in autonomous driving, benefits and challenges, system architecture

Unit 2: Perception and Sensors
Sensor technologies (LiDAR, RADAR, cameras), sensor calibration, object detection, semantic segmentation, data fusion techniques

Unit 3: Localization and Mapping
Localization methods, GPS and IMU integration, Simultaneous Localization and Mapping (SLAM), occupancy grid mapping, map-based localization

Unit 4: Path Planning and Control
Path planning algorithms (A*, RRT), trajectory generation, motion planning, control systems for autonomous vehicles, PID and MPC controllers

Unit 5: AI and Machine Learning in Autonomous Vehicles
Supervised and reinforcement learning for vehicle control, deep learning for perception, end-to-end learning for driving, safety, ethical and regulatory considerations in autonomous driving

Text Books:

1. Shaoshan Liu, Liyun Li, Jie Tang, *Creating Autonomous Vehicle Systems*, Morgan & Claypool Publishers.
2. Amir Khajepour, M. SaberFallah, AvestaGoodarzi, *Autonomous Vehicles: Autonomous Driving Systems*, CRC Press.

Reference Books:

1. Raj Madhavan, *Autonomous Ground Vehicles*, Artech House.
2. Phil Kim, *MATLAB Deep Learning for Autonomous Driving,* Apress.
3. Oliver Wasenmüller, Didier Stricker, *Computer Vision for Autonomous Vehicles*, Springer.

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New Scheme Based On AICTE Flexible Curricula

Robotics and Artificial Intelligence, VIII Semester

802(C) Design and Analysis of Machine Elements

Course Objectives:

1. To introduce the fundamental principles and procedures for designing machine elements.
2. To develop the ability to analyze stresses, strains, and failure theories in mechanical components.
3. To design components such as shafts, fasteners, and springs under various loading conditions.
4. To enable students to perform analysis and design of power transmission elements.
5. To enhance practical design skills using relevant standards and safety considerations.

Course Outcomes:

After completing this course, students will be able to:

CO1: Explain the fundamental concepts of mechanical design and failure analysis.
CO2: Analyze stresses, strains, and select materials for various machine components.
CO3: Design and analyze shafts, keys, couplings, and fasteners under static and dynamic loading.
CO4: Design and analyze springs and power transmission elements like belts and gears.
CO5: Apply design standards and safety considerations in machine element design.

Syllabus
Unit 1: Introduction to mechanical design, design process, types of loads, stress and strain analysis, theories of failure, factor of safety, material selection.
Unit 2: Design of shafts, keys, and couplings, design for strength and rigidity, analysis under torsion and bending, design of rigid and flexible couplings.
Unit 3: Design of threaded fasteners, bolted and welded joints, eccentrically loaded joints, design for fatigue loading.
Unit 4: Design of springs, helical and leaf springs, stress and deflection in springs, energy storage in springs, design for fluctuating loads.
Unit 5: Design of power transmission elements, flat belts, V-belts, chain drives, spur gears, gear design considerations, lubrication and wear.
Text Books:

1. V. B. Bhandari, *Design of Machine Elements*, Tata McGraw-Hill.
2. R. S. Khurmi, J. K. Gupta, *A Textbook of Machine Design*, S. Chand & Co.

Reference Books:

1. Shigley, Mischke, Budynas, *Mechanical Engineering Design*, McGraw-Hill.
2. M. F. Spotts, T. E. Shoup, *Design of Machine Elements*, Pearson.
3. P. C. Gope, *Machine Design: Fundamentals and Applications*, PHI Learning.

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New Scheme Based On AICTE Flexible Curricula

Robotics and Artificial Intelligence, VIII Semester

803(A) Augmented Reality and Virtual Reality

Course Objectives:

1. To introduce concepts of AR and VR and their technological foundations.
2. To explore hardware and software tools used for AR and VR development.
3. To understand interaction techniques and human factors in AR/VR systems.
4. To study AR/VR applications across industries.
5. To familiarize students with AR/VR content development workflows.

Course Outcomes:

CO1: Explain the principles and technologies behind AR and VR systems.
CO2: Identify and work with AR/VR hardware and software tools.
CO3: Apply interaction methods within AR/VR environments.
CO4: Analyze and evaluate AR/VR applications for various domains.
CO5: Develop simple AR/VR prototypes using relevant tools.

Syllabus:

Unit 1: Introduction to AR and VR, differences between AR and VR, historical background, applications, components of AR/VR systems.
Unit 2: Display technologies, sensors and tracking, input devices, AR markers, calibration techniques, AR SDKs.
Unit 3: 3D graphics for AR/VR, scene rendering, interaction techniques, gesture recognition, user interface design in immersive environments.
Unit 4: AR in mobile devices, VR simulation environments, gaming and training applications, healthcare applications, industrial AR/VR use cases.
Unit 5: Content creation workflows, AR/VR development tools, Unity and Unreal Engine basics, testing AR/VR applications, challenges and future trends.

Text Books:

1. Alan B. Craig, *Understanding Augmented Reality: Concepts and Applications*, Morgan Kaufmann.
2. Grigore C. Burdea, Philippe Coiffet, *Virtual Reality Technology*, Wiley.

Reference Books:

1. Dieter Schmalstieg, Tobias Hollerer, *Augmented Reality: Principles and Practice*, Addison-Wesley.
2. Jason Jerald, *The VR Book: Human-Centered Design for Virtual Reality*, ACM Books.

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New Scheme Based On AICTE Flexible Curricula

Robotics and Artificial Intelligence, VIII Semester

803(B) Blockchain Technology

Course Objectives:

1. To introduce blockchain concepts and their significance.
2. To understand blockchain architecture and working principles.
3. To explore cryptocurrencies and smart contracts.
4. To study blockchain applications across different sectors.
5. To analyze security and scalability challenges in blockchain.

Course Outcomes:

CO1: Explain blockchain fundamentals and architecture.
CO2: Describe the functioning of cryptocurrencies and smart contracts.
CO3: Analyze the use of blockchain in various applications.
CO4: Identify security, privacy, and scalability issues in blockchain systems.
CO5: Demonstrate basic blockchain implementation and simulation.

Syllabus:

Unit 1: Introduction to blockchain, distributed ledger, types of blockchain, components of blockchain, consensus mechanisms.
Unit 2: Blockchain architecture, blocks and transactions, mining, proof of work, proof of stake, Merkle trees.
Unit 3: Cryptocurrencies, Bitcoin, Ethereum, wallets, smart contracts, decentralized applications (DApps).
Unit 4: Blockchain in supply chain, healthcare, finance, voting systems, identity management, case studies of blockchain applications.
Unit 5: Blockchain security, privacy in blockchain, scalability issues, interoperability, blockchain frameworks and tools, future trends.

Text Books:

1. Imran Bashir, *Mastering Blockchain*, Packt Publishing.
2. Andreas M. Antonopoulos, *Mastering Bitcoin*, O'Reilly Media.

Reference Books:

1. Melanie Swan, *Blockchain: Blueprint for a New Economy*, O'Reilly Media.
2. ArshdeepBahga, Vijay Madisetti, *Blockchain Applications: A Hands-On Approach*, VPT.

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New Scheme Based On AICTE Flexible Curricula

Robotics and Artificial Intelligence, VIII Semester

803(C) Managing Innovation and Entrepreneurship

Course Objectives:

1. To understand the fundamentals of innovation and entrepreneurship.
2. To learn about the process of managing innovation within organizations.
3. To develop the ability to generate and evaluate business ideas.
4. To understand business models, funding, and marketing strategies for startups.
5. To study policies and support systems for entrepreneurship development.

Course Outcomes:

CO1: Explain the concepts of innovation and entrepreneurship.
CO2: Analyze the process of managing innovation in firms.
CO3: Develop and evaluate innovative business ideas.
CO4: Prepare business models and plans for entrepreneurial ventures.
CO5: Identify support systems and policies for entrepreneurs.

Syllabus:

Unit 1: Introduction to innovation, types of innovation, innovation management, entrepreneurship fundamentals, traits of entrepreneurs.
Unit 2: Managing creativity, idea generation techniques, innovation process, technology management, R&D strategies.
Unit 3: Business models, feasibility analysis, market research, business plan preparation, intellectual property basics.
Unit 4: Funding sources for startups, venture capital, angel investors, government support, marketing for startups.
Unit 5: Entrepreneurship development policies, incubators, accelerators, case studies of successful startups, challenges in entrepreneurship.

Text Books:

1. Peter F. Drucker, *Innovation and Entrepreneurship*, Harper Business.
2. Bessant, John and Tidd, Joe, *Innovation and Entrepreneurship*, Wiley.

Reference Books:

1. Thomas W. Zimmerer, Norman M. Scarborough, *Essentials of Entrepreneurship and Small Business Management*, Pearson.
2. Harvard Business Review Press, *HBR's 10 Must Reads on Innovation*.