Proposal for New Course under QIP PG Certification Program

1. Course Title

Robotics

2. Course Objectives

The PG certificate program in Robotics aims to provide college teachers with fundamental knowledge and practical skills in robotics, automation, and intelligent systems. The course is designed to enable participants to understand, design, program, and operate robotic systems for real-world applications.

Objectives:

- Introduce the fundamentals of robotics, sensors, actuators, and control systems.
- Develop skills in robot modeling, programming, and motion control.
- Provide knowledge of perception, navigation, and intelligent decision-making.
- Enable the integration of hardware and software for robotic applications.
- Foster problem-solving, innovation, and multidisciplinary teamwork.
- Prepare learners for research, and advanced studies in robotics and automation.

Alignment with Program Objectives: The course supports the program's goal of developing college teachers capable of contributing to robotics, automation, and intelligent systems through a combination of theoretical knowledge, practical experience, and innovative thinking.

3. Rationale for the Course

The AICTE–QIP PG Certificate Programme in **Robotics** is an interdisciplinary programme designed to equip engineering faculty members with fundamental and advanced knowledge of modern robotics technologies. The programme covers key areas such as robotic systems, automation, sensing, control, autonomous systems, and their applications in security and service robotics, healthcare and assistive robotics, smart agriculture, and other emerging domains. By combining theoretical foundations with practical exposure, the programme enables participants to enhance their teaching, research, and innovation capabilities, thereby supporting the effective delivery of Robotics, Automation, and Control-related courses in engineering education.

4. Programme Duration

- **Total Duration:** 6 Months (200 Hrs excluding evaluation)
- **Tentative Start Date:** 20/07/2026
- **Tentative End Date:** 24/12/2026

5. Mode of Delivery

Mode	Duration	Dates
Offline Sessions 1(On-Campus)	11 Days	From 20/07/2026 to 31/07/2026
Online Sessions 1	128 Days	From 01/08/2026 to 06/12/2026
Offline Sessions 2(On-Campus)	11 Days	From 07/12/2026 to 18/12/2026

4. Course Structure

Course Content (high-level)	Credits	Resources Name with designation	Specialization and year of Experience in the Domain
Core 1 – Robot Mechanics: Role of robots in the modern world, Introduction to Mechanics of Robots, Types and kinematics of mobile robots, Kinematics of wheeled mobile robots, Dynamics of wheeled mobile robots, Introduction to mobile manipulators, Dynamic simulation of robotic manipulators, Mechanics and control of mobile manipulator	2 (theory) + 2 (lab)	Prof. Santhakumar Mohan, Professor	Robotics, Motion Control, Mechanism Design and Analysis, Service and Field Robots, Underwater Vehicles and Manipulator Systems
Core 2 – Robot Motion Control: Classical control theory; transfer function, PID control: theory and simulation, State space, notion of stability, State space and stability of system, Modeling and Control of quad rotor, motion planning algorithms, Robot sensors overview	2 (theory) + 2 (lab)	Dr. Sneha Gajbhiye, Associate Professor	Stability/control of autonomous systems (robotics: ground/underwater/aerial vehicles); Geometric mechanics and nonlinear control; Optimal control; Adaptive control
Core 3 – Robot Autonomy: Overview, Optimization related to robotics, Optimal control, LQR control , State Estimation, Robot Navigation, Computer Vision: Camera calibration	1 (theory) + 1 (lab)	Dr. Shaikshavali Chitraganti, Associate Professor	Networked control systems, Optimal control, Reinforcement learning, Approximate dynamic programming

Core 4 – Robot Sensors and Processing: Multimodal Sensors for Robotics, Data acquisition (DAQ) Techniques, IoT Based Robot Control Experiments, Signal Processing in Robotics, Real-time Signal/Image Analysis Experiments, Robot Vision: Techniques & System, Image Processing in Robotics-Concepts, Sound/Vision Guided Navigation Experiments	1 (theory) + 1 (lab)	Prof. Sabarimalai Manikantan, Associate Professor	Signal Processing for Signal Quality Assessment, Noise Recognition, Denoising, Feature Extraction and Compression; VLSI Signal Processing Architectures for Energy-Efficient Event Detection and Monitoring Systems; AI/Machine Learning for Event Recognition, Research Area: Internet of Things - Energy Consumption Reduction Strategies, Cognitive Radios and Data Security; Multimodal Information Processing; Image Processing - RGB, RADAR, LiDAR, SONAR, Thermal/IR and Hyperspectral
Capstone Project - Hands-on / Applied project	3	Prof. Santhakumar Mohan, Professor	Robotics, Motion Control, Mechanism Design and Analysis, Service and Field Robots, Underwater Vehicles and Manipulator Systems

6. Learning Outcomes

Upon completion, learners will be able to:

- Understand and apply core robotics concepts.
- Program and control robotic systems.
- Integrate sensors and embedded technologies into robotic platforms.
- Develop and evaluate robotic solutions for real-world challenges.
- Utilize modern tools and techniques for robotics design and implementation.

7. Infrastructure and Resources Available

Infrastructure

The program is supported by a well-equipped robotics laboratory with high-performance computing facilities for hands-on training using industry-standard tools such as ROS, Gazebo, and MATLAB. Participants also have access to fabrication and prototyping facilities for developing and testing course projects.

Resources Available

- **Software:** ROS, Gazebo, MATLAB/Simulink
- **Hardware:** Mobile robotic platforms, controller development boards, sensors, FPGA kits, and embedded system development tools.

8. Expected Outcomes of the Course

Upon successful completion of the PG Certificate Course in Robotics, participants will be able to:

1. Understand the core principles of robotics, automation, and intelligent systems.
2. Model, analyze, and control robotic systems using modern tools and techniques.
3. Develop and program robotic applications using industry-standard software platforms.
4. Integrate sensors, actuators, and embedded systems into robotic solutions.
5. Design and implement robotic systems for real-world applications in various domains.
6. Apply acquired knowledge in teaching, research, and innovation activities related to robotics and automation.

9. Other Relevant Information

The program follows the academic framework of **IIT Palakkad** and comprises **18 credits**, integrating both theoretical foundations and hands-on practical learning. Participants will be assessed through continuous evaluation and course requirements throughout the programme. Upon successful completion, they will be awarded a **QIP–PG Certificate** jointly endorsed by **AICTE and IIT Palakkad**. The curriculum is designed with sufficient flexibility to accommodate emerging topics and evolving industry needs while maintaining the prescribed credit structure and learning outcomes.

Submitted by:

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- Designation: Professor
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