



# Professional Postgraduate Program in Intelligent Systems and Robotics (PPGP-ISR)

(Autonomous, full-time, 11 months, residential Program)

Increasingly, living on earth means living with robots and intelligent systems; sharing the planet with ever more intelligent machines that perform tasks from the mundane, like the lawn mower that cuts grass, to the highly specialized like robot-doctors that do surgery. Robotics is a rapidly developing discipline that combines long-established areas of electronics and mechanical engineering with novel approaches in computing and life sciences. Intelligent systems and easy reconfiguration have made Robotics more applicable and cost effective in industries. Intelligent systems use ideas and get inspiration from natural systems, and build on both established and novel techniques from machine learning, artificial intelligence and mathematical optimization. Considering the human resource requirement in the Robotics and Automation Industry in India, the Program has been designed to equip students with necessary hardware and software skills.

This 11 month, full-time, Professional Postgraduate Program in Intelligent Systems and Robotics focuses on the following domains:

- Robotics
- Intelligent Systems
- Embedded System Design
- Electromechanical System Integration

## Distinctive Features

- Well-structured theory and laboratory sessions to gain experience of practical situations in Robotic System Design for various applications
- Every student will be provided with personal Robotic Mini laboratory
- Collaboration with leading institutes and industry to keep pace with industrial needs and requirements
- Expert lectures, seminars and case studies by leading experts from industries
- Twelve weeks full time projects to enhance the understanding of real-life scenarios in the chosen area of technology

## Eligibility

- Graduates with a Bachelor's Degree in Engineering / Technology in Electrical / Electronics / Communication / Information Technology / Computer Science / Instrumentation / Mechanical / MSc Physics / Electronics or equivalent (with minimum 50 percent marks or equivalent grades)
- Basic Knowledge of Electronics and Mechanics
- Programming Background in C

## Basic Courses:

**CS001 / CS002 / CS003 Life Skills Development – I / II / III (Each 20 Hours):** The Life Skills Development Program prepares students for communication and interaction in an organizational set-up. The focus would be on grammar, vocabulary, spoken English, remedial English, presentation skills, debates, group discussions, team building, time management, cross-cultural communication, creative and business writing. The ultimate objective of this course is to develop individuals with high intelligence and emotional quotients who are also competent speakers of English. At the end of the Life Skills Development Program the students would be well equipped with language skills, soft skills and life skills to enter the challenging corporate world.

## Bridge Courses:

**ISR001 Introduction to Electronic Design (15 Hours):** The module covers hands-on training on fundamental aspects of electronics components, circuit design, testing and troubleshooting.

**ISR002 Introduction to Mechanics (15 Hours):** The module covers hands-on training on introduction to various tools, procedures and methodologies those are required to adopt in electronic circuit design and in embedded robotics.

## Foundation Courses:

**ISR501 Methods and Tools for Applied Artificial Intelligence (60 Hours):** Introduction to Artificial Intelligence. Methods and Tools. Applied Neural Networks. Fuzzy Logic. Intelligent System

Design. AI Programming

**ISR502 Robotics Fundamentals (60 Hours):** Introduction to Robotics. History of Robotics. Effectors. Actuators. Sensors, Complex Sensors. Feedback control. Deliberative and Hybrid control. Robot Learning, Robotic Behavior. Group Robotics. Kinematics. Dynamics.

**ISR503 Embedded System Design (60 Hours):** Programmable Devices. Introduction to Real time System. Hardware and software interface. Role of Microcontrollers (80851, AVR controllers, PIC microcontroller). Embedded System Configuration. Interface for Sensors and Actuators. Bus System for Embedded System. Embedded Programming.

**ISR504 Signal Processing for Intelligent Systems and Robotics (60 Hours):** Review of Signals and System. Digital Control system fundamentals. Real Time Processing, System Characterization, DTFT, DFT, z-transform, FIR and IIR Filters, DSP with FPGA and DSP Processors.

**ISR505 Artificial Intelligence and Fuzzy Logic (60 Hours):** Back propagation, Perception Model, Genetic Algorithm, Self Organization Learning, Simulation Agent based Learning, Simulation and Development fuzzy Inference Systems and Fuzzy Decision Making.

## Core Courses:

**ISR601 Sensors and Actuators for Intelligent Systems and Robotics (60 Hours):** Sensor Principles. Sensor Physics. Sensor Construction and Coupling. Internal and External Sensors, Sensor types and interfaces using controllers. Amplifiers for sensors Smart Sensors and interface. Actuators. Types of Actuators. Actuator Coupling with Controllers. DC Motors. Stepper Motors. Servo Motors and Interfaces.

**ISR602 Electromechanical Systems and Modeling (60 Hours):** Mechanical Elements. Mechanical Transmission. Gearboxes. Pulley, Belt and Chains. Linear and Rotary Bearings. Machine Screws and Splined Shafts. Systems Integration. Rotary and Linear Electric Motors. Shafts Integration. Systems modeling and control. Novel Controllers. System Performance Measures. Controllers PC and PLC. Embedded Software for Control. Languages and Platforms.

**ISR603 Tele-Robotics (60 Hours):** Remote Engineering. Remote Control and Sensing. Design of Digital Control System. Tele Operation of Electromechanical system, Mobile and Wireless control. FM Control. Blue tooth Control. Control through Computer and Internet. Transceiver Architecture and Design of Hardware for Different Wireless Standards.

**ISR604 Industry Perspective Seminars (40 Hours):** In the initial part of this module, Industry experts will be invited the deliver talks on state-of-the-art technologies and happenings in the Industry to

enable students to know the industry requirements. In the later part, the students have to present seminars on the latest topics in their domain.

### Advanced Courses:

**ISR701 SOC for Robotics (60 Hours):** Review VHDL Programming, FPGA/CPLD introduction, State machine design, Testbench Design, Designing with microcontroller, Implementation of hardware drivers, Board Design for Robotics, peripherals design, FPGA application for sensors interface and actuators interface, ROBOT vision using FPGA interface, Interactive system Design using FPGA.

**ISR702 Machine Vision (60 Hours):** Machine Vision. Robot Guidance. Hardware Elements. Lighting. Camera. Optical Configuration. Frames-store. Resolution And Field of View. Monochrome And Color. Image Acquisition and Display. Photosensitive Devices. Digitization. 2D Menstruation. Erosion and Dilation. Skeletonization. Histogram Analysis. Image preprocessing. Brightness/Contrast Enhancement. Standard Mappings. Negation. Thresholding. Sharpening. Smoothing. Convolution. Feature Extraction. Area, Perimeter and Shape Descriptions.

**ISR703 Intelligent Mobile Robots (70 Hours):** Introduction to Mobile Robots. Intelligent Sensors. Data Fusion. Knowledge

Representation. Behaviour Representation. Mapping and Localization. Navigation and Path Planning. Adaptive Robotics. Cognitive Robotics.

### Project:

**ISR801 Projects (400 Hours):** Students can take up an industry-sponsored project or in-house project as one of the requirements of this program. For industry-sponsored projects, the Career Management Center facilitates interaction between students and the industry. The students can also take up the in-house projects under the guidance of the faculty and/or industry experts in their area of expertise. Students are encouraged to work on projects that will enhance their understanding in certain technology domains in real-life scenario. The project report has to be submitted to the Institute in the prescribed format, which experts nominated by the Institute will examine. The project is the culmination of the student's learning in the Institute and is expected to be of high standards as demanded by the industry from time to time.

**Robotics Mini laboratory:** The complete program will be based on the Robotics Mini laboratory, which will be provided to each student. It will have 500 electronics and mechanical tools and components to give complete practical experience of designing, creating and documenting working Robots to support the subjects taught in the course.

Program Structure			
Level	Subject Code	Subject Name	Hours
Basic	CS001	Life Skill Development – I	20
	CS002	Life Skill Development – II	20
	CS003	Life Skill Development – III	20
Bridge	ISR001	Introduction to Electronics Design	15
	ISR002	Introduction to Mechanics	15
Foundation	ISR501	Methods and Tools for Applied Artificial Intelligence	60
	ISR502	Robotics Fundamentals	60
	ISR503	Embedded System Design	60
	ISR504	Signal Processing for Intelligent Systems	60
	ISR505	Artificial Intelligence and Fuzzy Logic	60
Core	ISR601	Sensors and Actuators for Intelligent Systems & Robotics	60
	ISR602	Electromechanical System	60
	ISR603	Tele-Robotics	60
	ISR604	Industry Perspective Seminar	40
Advanced	ISR701	System On Chip in Robotics	60
	ISR702	Machine Vision	60
	ISR703	Intelligent Mobile Robots	70
Project	ISR801	Project	400
			<b>Total Hours: 1200</b>