

CSIR-PGRPE-2011 Programme Brochure

(2011-2013)

Two-year Post-Graduate Research Programme in Engineering (PGRPE) in Advanced Electronic Systems at CSIR-CEERI, Pilani

This programme aims to provide in-depth exposure to the engineering concepts, research methodology and hands-on experience on advanced real-life R&D projects in different application areas such as Process Control Instrumentation, Digital Signal and Image Processing, Embedded Systems, and Power Electronics. Students completing this two-year programme will be fully research-enabled and industry-ready.

Modern electronic systems engineering requires designers and users to understand various paradigm changes in the development of electronic systems. From the earlier period of designing electronic systems with discrete devices and few ICs; the technology, with enhanced power of computation and speed, has advanced to electronic system design based on the use of sensors, FPGAs, ASICs, DSPs and microcontrollers with real-time operating systems for various applications such as image processing, smart instrumentation, wireless sensor networking, communications, power electronics and drives, and process control instrumentation. With the advent of powerful system specification, modeling, design and simulation tools, the time from concept to implementation has been considerably reduced. This has been accompanied with increase in functional complexity.

This programme offers a unique opportunity to electronics, instrumentation, electrical, computer and other engineers to understand the nuances of advanced electronic systems and embedded systems as well as to have hands-on experience on the development of such systems.

The first and second semesters focus on the study of core advance-level subjects and associated laboratories related to understanding of the principles of electronic system design with emphasis on the use of modern tools in modeling, simulation, design and testing of electronic systems.

The third and fourth semesters give the opportunity to the candidates to effectively utilize the knowledge acquired through the courses towards advanced R&D project work and dissertation in their areas of interest.

The laboratory facilities and research expertise of the scientists acting as faculty and mentors further adds to the programme's uniqueness.

In addition, on successful completion of the programme with distinction, the candidates may be considered by CSIR for absorption as Scientists in PB-3 of the Government of India (Scale of Rs. 15600/- to 39100/- with Grade Pay of Rs. 6600/- plus other allowances as applicable).

The medium of instruction and evaluation is English.

Number of Seats in the Programme

The total number of seats available is 8.

Admission Process and Eligibility for Admission

Please see the CSIR-PGRPE-2011 website at <http://pgrpe.csio.res.in/> for on-line submission of the admission form and details of eligibility.

Fellowship

Fellowship amount of **Rs. 25,000 per month** will be awarded to selected candidates during the two-year programme. The selected candidates will be designated as “Scientist Trainee” under the CSIR QHS scheme.

Programme Fee Structure

1. One-time Admission Fee (non-refundable) : Rs. 4,000.
2. One-time Security Deposit (refundable) : Rs. 6,000.
3. Semester Fees (non-refundable) : Rs. 24,000.

Students wanting to withdraw from the programme after deposit of fees and security amount will need to apply in writing for refund. If such an application is made on or before July 31, 2011 at CEERI, refund of fees/other charges will be made after deducting the admission fee amount of Rs. 4,000.

No refund of fees/other charges will be made if the student leaves after joining the programme except for the security deposit / caution money amount of Rs. 6,000.

Total amount of Rs. 34,000 needs to be deposited at the time of admission. Subsequently, only the semester fees of Rs. 24,000 needs to be deposited before the start of every semester.

For NEFT bank transfer, please transfer the amount to the saving account number 61033385318 of “Director, CEERI” at SBBJ, Pilani (IFSC code SBBJ0010398) with appropriate narration statement.

In case of Demand Draft, please get it issued in favour of “Director, CEERI” payable at Pilani and post it by speed post or registered letter to “Director, CEERI, Pilani – 333 031” with your name written in pencil on the reverse side of the demand draft.

Important Dates

1. Last date for receipt of on-line application form on CSIR-PGRPE website : May 23, 2011.
2. Programme registration at CSIR-CEERI, Pilani : August 08-09, 2011.
3. Start of first semester at CSIR-CEERI, Pilani : August 09, 2011.

The detailed academic programme calendar will be made available before the start of each semester.

Please visit the CSIR-PGRPE-2011 website at <http://pgrpe.csio.res.in/> for more information. You should also periodically visit CEERI's website link for CSIR-PGRPE-2011 at <http://www.ceeri.res.in/> for updates and news about this programme.

Semester-wise Scheme : Advanced Electronic Systems

Semester-I

Subject Code	Subject	Credits
AES 601	System Design for Process Control Applications	3
AES 602	System Modeling and Design Languages	3
AES 603	Intelligent Sensor Systems	3
AES 611	Lab: System Design for Process Control Applications	2
AES 612	Lab: System Modeling and Design Languages	2
AES 613	Lab: Intelligent Sensor Systems	2
AES 551	Technical Communications	2
AES 552	Research Methodology	1

Semester-II

Subject Code	Subject	Credits
AES 621	Real-time Embedded System Design	3
AES 622	Advanced Signal and Image Processing	3
AES 623	Power Electronics and AC/DC Drives	3
AES 631	Lab: Real-time Embedded System Design	2
AES 632	Lab: Advanced Signal and Image Processing	2
AES 633	Lab: Power Electronics and AC/DC Drives	2
AES 651	Project Management	2

Semester-III

Subject Code	Subject	Credits
AES 701	Advanced Self-study on Special Topic	4
AES 661	Project Work and Seminar	14

Semester-IV

Subject Code	Subject	Credits
AES 671	Dissertation Seminar and Viva-voce	4
AES 672	Dissertation Report	14

Brief Course Descriptions : Advanced Electronic Systems

AES 601 : System Design for Process Control Applications (3-0-0-3) 3 Credits

Faculty Coordinators : Dr. S. S. Sadistap; Dr. B. A. Botre

Virtual instrumentation and measurements, Virtual instrument design approach using LabView; Data acquisition modules; Electronic system trends, design options, metrics and considerations; Electronic system development cycle; PIC family of microcontrollers based system design and programming; Interfacing techniques for memory and I/O devices; Process control and instrumentation; Process simulation and modeling; Design case studies.

AES 602 : System Modeling and Design Languages (3-0-0-3) 3 Credits

Faculty Coordinators : Dr. Kota Solomon Raju; Sh. Rahul Varma

Overview of the system specification, modeling and design methodologies; Untimed model of computation; Synchronous model of computation; Timed model of computation; Modeling of computation interfaces; Basic concepts of system design specification, modeling and simulation using VHDL, SystemC, and UML; Transaction level modeling (TLM) based methodologies; Fundamentals of system design using Saber.

AES 603 : Intelligent Sensor Systems (3-0-0-3) 3 Credits

Faculty Coordinators : Dr. P. C. Panchariya; Dr. P. Bhanu Prasad

Primary sensing principles and measurement variables; Sensor performance characteristics and terminology; Transducer measurement circuits; Signal conditioning circuits; Data conversion; Virtual instrumentation with LabView; Introduction of soft-computing techniques; Foundations of fuzzy approaches; Fuzzy rule based systems; Fundamentals of neural networks; Implementation of various learning algorithms; Competitive, associative and other special neural networks; Practical aspects of neural networks; Neural methods in fuzzy systems; Introduction to statistical pattern recognition; Dimensionality reduction; Classification; Validation; Data analysis with MATLAB; Introduction to intelligent sensor system and their structures; Advanced processing and control techniques; Smart sensors; Case study: the “electronic nose”; The future of intelligent sensor systems.

AES 611 : System Design for Process Control Applications Laboratory (0-0-4-2) 2 Credits

Faculty Coordinators : Dr. S. S. Sadistap; Dr. B. A. Botre

Laboratory practices and safety considerations; LabView usage and programming; Data acquisition module programming; Using PIC family of microcontrollers for electronic systems design; Buses and Interfacing memory and I/O devices; Process simulation and modeling.

AES 612 : System Modeling and Design Languages Laboratory (0-1-3-2) 2 Credits

Faculty Coordinators : Dr. Kota Solomon Raju; Sh. Pramod Tanwar

Laboratory practices and safety considerations; Understand Xilinx FPGA architecture; Introduction to designing with Xilinx FPGAs using Xilinx EDK, Core Generator; Architecture wizard and pin assignment; ChipScope; Design of DSP sub-blocks using SysGen; Designing system blocks using synthesis tools; System design using Saber tools for various applications.

AES 613 : Intelligent Sensor Systems Laboratory (0-0-4-2) 2 Credits

Faculty Coordinators : Dr. P. C. Panchariya; Sh. Santosh Kumar

Laboratory practices and safety considerations; Sensor interfacing; Signal conditioning of various sensors such as temperature, gases, pressure, humidity etc.; sensor calibration and excitation; Data acquisition; Virtual instrument and GUI design; Analog and digital I/O; File I/O; Integration of sensor, DAQ and GUI modules; implementation of pattern analysis methods; Signal preprocessing; Dimensionality reduction; Classification; Implementation of Fuzzy systems; Implementation of neural network algorithms; Time series forecasting; Implementation of neuro-fuzzy algorithms on real-world data sets.

AES 551 : Technical Communications (2-1-0-2) 2 Credits (Same as ASE 551 and MDSE 551)
Faculty Coordinator : Sh. Raj Singh

Role and importance of technical communication; Effective written and oral communication; Ethical issues; Technical report writing; Technical/R&D proposals; Research paper writing; Letter writing and official correspondence; Emails; Oral communication in meetings and group discussions; Oral presentations; Use of modern aids.

AES 552 : Research Methodology (1-1-0-1) 1 Credit (Same as ASE 552 and MDSE 552)
Faculty Coordinator : Sh. Raj Singh

Introduction, terminology, and scientific methods; Types of research; Research process and steps; Identifying a research problem; Literature survey, appreciation of existing literature, identification of knowledge gaps; Conception of novel approach to solve the problem; Role of theory, modeling, and simulation; Design of experiments, testing and characterization strategies; Quantitative methods and data analysis; Qualitative analysis; Communicating research results; Ethics in research.

AES 621 : Real-time Embedded System Design (3-0-0-3) 3 Credits
Faculty Coordinators : Dr. Kota Solomon Raju; Sh. H. D. Sharma; Sh. Pramod Tanwar

Fundamentals of FPGA-based system design, Architecture of embedded processors, Advanced processor architecture concepts, architectures for digital signal processing and applications; Designing soft processors with FPGAs; Power/energy efficient embedded system design; Real-time programming and communication; Concurrent Programming, Synchronization and communication; Scheduling of uni-processor and multi-processors; Real-time operating systems (RTOS) organization, Concept of kernel design, RTOS scheduling, Case studies of VxWorks, QNX, TinyOS, and others; Programming with QNX or VxWorks; Embedded hardware building blocks, Embedded system level design, design space exploration and verification techniques.

AES 622 : Advanced Signal and Image Processing (3-0-0-3) 3 Credits
Faculty Coordinators : Dr. J. L. Raheja; Dr. A. Karmakar

Discrete-Time Signals and systems in time domain; Time-domain characterization of Linear Time Invariant (LTI) Discrete-Time Systems (DTS); Discrete Time Fourier Transform (DTFT), Discrete Fourier Transform (DFT), z-transform; LTI DTS in the frequency domain : transfer function, frequency response; Simple digital filters; 2-D filters; FIR and IIR filter design; DSP algorithm implementation issues and finite word length effects; Image sensor models; Image representations and properties; Noise models, Image de-noising, Image pre-processing; Segmentation, Histogram, Histogram equalization and its application; Edge detection algorithm; Motion detection algorithm; Application of edge, face and motion detection; Hough transform and its application.

AES 623 : Power Electronics and AC/DC Drives (3-0-0-3) 3 Credits
Faculty Coordinators : Sh. Rahul Varma; Sh. A. K. Dhakar

Power Electronics : Need of Power conversion, Applications of power electronics; Power semiconductor devices : Diode, Thyristor, MOSFET, IGBT; Line frequency diode rectifiers; Switch-Mode DC-DC Converters : Introduction, Step-down (buck), Step-up (boost), Buck-boost, full-bridge DC-DC converter and comparison; Introduction of high-frequency inductors and transformers; Switch-mode DC-AC inverters : Single-phase, three-phase inverters, Effect of Blanking time; Switching DC power supplies : Overview of switching power supplies, DC-DC converters with electrical isolation, Control of switch-mode DC power supplies, Electrical isolation in the feed-back loop, designing feedback controllers in switch-mode DC power supplies; Power factor correction (PFC) Circuits; Introduction of soft-switching in DC-DC Converters; Introduction to electric drive systems. Understanding mechanical system requirements for electric drives; Basic principles of electro-mechanical energy conversion; DC motor drives and electronically-commutated motor drives; Introduction to AC machines and space vectors; Induction motors : balanced, sinusoidal steady-state operation and speed control.

AES 631 : Real-time Embedded System Design Laboratory (0-1-3-2) 2 Credits
Faculty Coordinators : Dr. Kota Solomon Raju; Sh. Pramod Tanwar

Laboratory practices and safety considerations; Understanding of developing a PowerPC and MicroBlaze based embedded system by using Xilinx Embedded Development Kit (EDK); Basic hardware design steps; Adding a processor system to a FPGA Design; Adding IP to a hardware design; Adding custom IP to the bus; writing software applications; System simulation with RTOS support; Multi-processor system design and implementation.

AES 632 : Advanced Signal and Image Processing Laboratory (0-1-3-2) 2 Credits
Faculty Coordinators : Dr. J. L. Raheja; Dr. A. Karmakar

Laboratory practices and safety considerations; MATLAB experiments on LTI systems in time and frequency domain, transfer function, frequency response; Design of digital FIR filters using windowing, frequency sampling; Design of digital IIR filters using impulse invariant, bilinear transform method; Two-channel and multi-channel orthogonal filter bank design; MATLAB experiments on color space conversion, basic image processing operations; Implementing various edge detection techniques; Real-time implementation of edge detection using DSP board; MATLAB experiments on histogram equalization, face detection and motion detection.

AES 633 : Power Electronics and AC/DC Drives Laboratory (0-1-3-2) 2 Credits
Faculty Coordinator : Sh. A. K. Dhakar

Laboratory practices and safety considerations; Familiarization with power electronic components, Line frequency diode rectifiers, Different PWM techniques, Switch-mode DC-DC Converters, Single-phase and three-phase inverter, DC-DC isolated converters, Speed control of DC motor, Brushless DC motor drive, AC motor drives.

AES 651 : Project Management (2-1-0-2) 2 Credits (Same as MDSE 651 and ASE 651)
Faculty Coordinator : Sh. Raj Singh

Introduction; Project formulation, evaluation and initiation; Project planning and scheduling; Resource allocation; Time management; Risk management; Project implementation; Project monitoring and control; Project closure; Project documentation; Complex projects; Advances and trends.

AES 701 : Advanced Self-study on Special Topic (1-1-6-4) 4 Credits
Faculty Coordinators : Senior Scientists

This will involve readings from published literature or books about new frontiers on a specific topic related to the field of electronic systems under guidance of senior scientist(s). A report needs to be submitted and a seminar on the special topic needs to be presented.

List of Faculty Members : Advanced Electronic Systems

S. No.	Name	Designation	Discipline
1.	Dr. Chandra Shekhar	Director	Microelectronics/VLSI Design
2.	Sh. Rahul Varma	Scientist G	Power Electronics and AC/DC Drives
3.	Sh. Raj Singh	Scientist G	Microelectronics/VLSI Design
4.	Dr. P. Bhanu Prasad	Scientist G	Electronic Instrumentation
5.	Dr. J. L. Raheja	Scientist F	Image Processing
6.	Dr. S. S. Sadistap	Scientist E-II	Electronic Instrumentation
7.	Dr. P. C. Panchariya	Scientist E-II	Electronic Instrumentation
8.	Dr. A. Karmakar	Scientist E-II	Signal Processing/VLSI Design
9.	Dr. K. Solomon Raju	Scientist E-I	Digital Systems Engineering
10.	Sh. A. K. Dhakar	Scientist C	Power Electronics and AC/DC Drives
11.	Sh. H. D. Sharma	Scientist C	Mechatronics/Embedded Systems
12.	Sh. Pramod Tanwar	Scientist C	Digital Systems/Embedded Systems
13.	Dr. B. A. Botre	Scientist C	Instrumentation/Embedded Systems
14.	Sh. Santosh Kumar	Scientist C	Electronic Instrumentation
15.	Dr. A. S. V. Sarma	Scientist G	Electronic Instrumentation
16.	Dr. A. Gopal	Scientist F	Electronic Instrumentation
17.	Dr. R. Govindraj	Scientist E-II	Electronic Instrumentation