CSIR-PGRPE-2012 Programme Brochure

(Admission Session : August, 2012)

Integrated MTech-PhD Programme in Advanced Electronic Systems at CSIR-CEERI, Pilani

The integrated MTech-PhD programme has two segments:

1. MTech programme of 2 years duration spread over 4 semesters.
2. PhD programme of 3 years duration after the successful completion of the MTech programme. Continuation into the PhD programme will be decided on case-by-case basis.

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 integrated 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.

The programme offers an 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 of the first year of the programme 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 of the programme 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.

The medium of instruction and evaluation is English.

Number of Seats in the Programme

The total number of seats available is 6.

Admission Process and Eligibility for Admission

Please see the AcSIR website at http://acsir.res.in/ and http://acsir-imp.csio.res.in/ for on-line submission of the admission form and details of eligibility.

Fellowship

Fellowship amount will depend on selection as TS (Trainee Scientist) or as a Sponsored Candidate.

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 August 10, 2012 at CSIR-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 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 the duration of the MTech programme. The tuition fees during PhD programme is Rs. 1,000 per month.

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

In case of Demand Draft, please get it issued in favour of "Director, CSIR-CEERI" payable at Pilani and post it by speed post or registered letter to "Director, CSIR-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 AcSIR website : June 23, 2012.
2. Programme registration at CSIR-CEERI, Pilani : August 13, 2012.
3. Start of first semester at CSIR-CEERI, Pilani : August 14, 2012.

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

Please visit the AcSIR website at http://acsir.res.in/ and http://acsir-imp.csio.res.in/ for more information. You should also periodically visit CSIR-CEERI's website link for CSIR-PGRPE-2012 at http://www.ceeri.res.in/ for updates and news about this programme.

MTech Programme : Semester-wise Scheme : Advanced Electronic Systems

Semester-I

Subject Code	Subject	L-T-P-C
ENG(CEERI) : 2-208	System Design for Process Control Applications	3-0-0-3
ENG(CEERI) : 2-209	System Modeling and Design Languages	3-0-0-3
ENG(CEERI) : 2-210	Intelligent Sensor Systems	3-0-0-3
ENG(CEERI) : 2-215	Lab: Process Control Applications	0-0-4-2
ENG(CEERI) : 2-216	Lab: System Modeling	0-0-4-2
ENG(CEERI) : 2-217	Lab: Intelligent Sensor Systems	0-0-4-2
ENG(CEERI) : 1-206	Technical Communications	2-0-0-2

Semester-II

Subject Code	Subject	L-T-P-C
ENG(CEERI) : 2-211	Real-time Embedded System Design	3-0-0-3
ENG(CEERI) : 2-212	Advanced Signal and Image Processing	3-0-0-3
ENG(CEERI) : 2-213	Power Electronics and AC/DC Drives	3-0-0-3
ENG(CEERI) : 2-218	Lab: Real-time Embedded System Design	0-0-4-2
ENG(CEERI) : 2-219	Lab: Advanced Signal and Image Processing	0-0-4-2
ENG(CEERI) : 2-220	Lab: Power Electronics and AC/DC Drives	0-0-4-2
ENG(CEERI) : 2-206	Project Management	2-0-0-2

Semester-III

Subject Code	Subject	L-T-P-C
ENG(CEERI) : 3-002	Advanced Self-study on Special Topic	0-2-4-4
ENG(CEERI) : 2-098	MTech Dissertation-I	0-7-14-14

Semester-IV

Subject Code	Subject	L-T-P-C
ENG(CEERI) : 2-099	MTech Dissertation-II	0-9-18-18

MTech Programme : Brief Course Descriptions : Advanced Electronic Systems

ENG(CEERI) : 1-206 : Technical Communication : 2-0-0-2
Course Coordinator: 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.

ENG(CEERI) : 2-206 : Project Management : 2-0-0-2
Course Coordinator: Raj Singh

Introduction; Project formulation, evaluation and initiation; Project planning and scheduling; Risk management; Project execution and implementation; Project monitoring and control; Project closure; Project documentation; Leadership and teamwork issues; Complex projects; Advances and trends.

ENG(CEERI) : 2-208 : System Design for Process Control Applications : 3-0-0-3
Course Coordinator: S. S. Sadistap and 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.

ENG(CEERI) : 2-209 : System Modeling and Design Languages : 3-0-0-3
Course Coordinator: K. Solomon Raju and 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.

ENG(CEERI) : 2-210 : Intelligent Sensor Systems : 3-0-0-3
Course Coordinator: P. C. Panchariya and 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.

ENG(CEERI) : 2-211 : Real-time Embedded System Design : 3-0-0-3
Course Coordinator: K. Solomon Raju

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.

ENG(CEERI) : 2-212 : Advanced Signal and Image Processing : **3-0-0-3**
Course Coordinator: J. L. Raheja and 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.

ENG(CEERI) : 2-213 : Power Electronics and AC/DC Drives : 3-0-0-3
Course Coordinator: Rahul Varma and 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.

ENG(CEERI) : 2-215 : Process Control Applications Laboratory : 0-0-4-2
Course Coordinator: B. A. Botre and S. S. Sadistap

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.

ENG(CEERI) : 2-216 : System Modeling Laboratory : 0-0-4-2
Course Coordinator: K. Solomon Raju, Pramod Tanwar and Rahul Varma

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.

ENG(CEERI) : 2-217 : Intelligent Sensor Systems Laboratory : 0-0-4-2
Course Coordinator: P. C. Panchariya and 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.

ENG(CEERI) : 2-218 : Real-time Embedded System Design Laboratory : 0-0-4-2
Course Coordinator: K. Solomon Raju and 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.

ENG(CEERI) : 2-219 : Advanced Signal and Image Processing Laboratory : 0-0-4-2
Course Coordinator : J. L. Raheja and 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.

ENG(CEERI) : 2-220 : Power Electronics and AC/DC Drives Laboratory : 0-0-4-2
Course Coordinator : 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.

ENG(CEERI) : 3-002 : Advanced Self-study (Special Topic) : 0-2-4-4
Course Coordinator : Senior Scientists

This will involve readings from published literature or books about new frontiers on a specific topic related to the field of electronics 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	Chief Scientist	Power Electronics and AC/DC Drives
3.	Sh. Raj Singh	Chief Scientist	Microelectronics/VLSI Design
4.	Dr. P. Bhanu Prasad	Chief Scientist	Electronic Instrumentation
5.	Dr. S. A. Akbar	Sr. Princ. Sc.	Control Systems
6.	Dr. J. L. Raheja	Sr. Princ. Sc.	Image Processing
7.	Dr. S. S. Sadistap	Sr. Princ. Sc.	Electronic Instrumentation
8.	Dr. P. C. Panchariya	Princ. Sc.	Electronic Instrumentation
9.	Dr. A. Karmakar	Princ. Sc.	Signal Processing/VLSI Design
10.	Dr. K. Solomon Raju	Princ. Sc.	Digital Systems Engineering
11.	Sh. A. K. Dhakar	Scientist	Power Electronics and AC/DC Drives
12.	Sh. H. D. Sharma	Scientist	Mechatronics/Embedded Systems
13.	Sh. Pramod Tanwar	Scientist	Digital Systems/Embedded Systems
14.	Dr. B. A. Botre	Scientist	Instrumentation/Embedded Systems
15.	Sh. Santosh Kumar	Scientist	Electronic Instrumentation
16.	Dr. A. S. V. Sarma	Chief Scientist	Electronic Instrumentation
17.	Dr. A. Gopal	Sr. Princ. Sc.	Electronic Instrumentation
18.	Dr. R. Govindraj	Princ. Sc.	Electronic Instrumentation