

AcSIR-IMP-2013 Programme Brochure

(Admission Session : August, 2013)

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 full-time 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 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 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 JRF (NET-Engg-JRF or GATE-JRF).

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 before 7 days to the start of first semester session 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 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 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. *This is the preferred mode of transaction for the depositing the amount.*

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

All important dates will be announced on AcSIR website at <http://acsir.res.in/>.

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 AcSIR-IMP-2013 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 Communication	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) : 2-222/ ENG(CEERI) : 2-223	Elective-I (Unit Processes in Semiconductor Technologies; CMOS Digital VLSI Design)	3-0-0-3
ENG(CEERI) : 2-225/ ENG(CEERI) : 2-226	Lab: Elective-I Related (Semiconductor Processing Technologies; CMOS-based Physical Design)	0-0-4-2
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 S. A. Akbar

Measurement techniques and instruments for various processes; Functional elements of control system; Design and analysis of SISO/MIMO feedback control system; Feed forward and adaptive control strategies; Functional Analysis : fundamental and common non-linearities; Phase plane analysis, limit cycles and linearization; Stability concept, methods, disturbances and analysis; P, PI, PID control analysis, design, implementation, comparison and applications; Virtual instrument design approach for industrial control; Introduction to PIC microcontrollers family architecture, programming; Interfacing techniques for memory, I/O devices, peripherals; Modern control concepts: static and dynamic optimization, self-tuning control, sliding mode control; Typical applications and project 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; Introduction of soft-computing techniques; Foundations of fuzzy approaches, fuzzy relationships and fuzzy numbers; Fuzzy rule-based systems; Fuzzy modelling; Fundamentals of neural networks;; Back propagation and related training algorithms; Competitive, associative and other special neural networks; Practical aspects of neural networks; Fuzzy and neural control; Introduction to statistical pattern recognition; Dimensionality reduction and classification; Case study: “electronic nose”; Smart sensors; Future trends in 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

Continuous Wavelet Transform (CWT): definition, CWT as correlation, constant Q-factor filtering and time-frequency resolution, inverse CWT; Fundamentals of Multirate signal processing: Fourier domain interpretation of decimation and interpolation, error cancellation in quadrature mirror filterbank (QMF); Discrete wavelet transform (DWT): multiresolution analysis and orthogonal wavelet decomposition, scaling function and wavelet function; Spatial/2-D convolution and separable Filters; 2-D DWT; Overview of applications of DWT and 2-D DWT; Image Sensor models; Image representations and properties; Noise models, image de-noising, image pre-processing; Segmentation; Morphological image processing: basic concepts, edge detection algorithm; Histogram, histogram equalization and its application; Motion detection algorithm; Application of edge, face and motion detection; Circular Hough transforms and applications; Introduction to pattern recognition; Principle component analysis (PCA) and its application for gesture recognition; Introduction to neural networks and its application for gesture recognition.

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 isolation, Control of switch-mode DC power supplies, Electrical isolation in the feedback 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 Saikrishna V.

Laboratory practices and safety considerations; LabView usage and programming; Assembling/populating PCBs for process control applications; PIC and dsPIC platform programming; Process parameters monitoring (RO plant case study); Control of actuators, valves and pumps (RO plant case study); Flow monitoring and control (e-nose case study); Data analysis using e-nose and GC/MS system; Mini-project.

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; Sensor calibration and excitation techniques; Virtual instrument and GUI design; Analog and digital I/O; File I/O; Integration of sensor, DAQ and GUI modules; Study of Matlab/Scilab; Implementation of Fuzzy systems and algorithms; Implementation of neural network algorithms; Implementation of neuro-fuzzy algorithms on real-world data sets; Implementation of signal processing

algorithms; Implementation of dimensionality reduction algorithms; Implementation of classification algorithms.

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; Continuous Wavelet Transform (CWT), Discrete Wavelet Transform (DWT), Multirate signal processing, perfect reconstruction and a mini-project on wavelet transform based application; Experiments on various color models; Image pre-processing; Segmentation; Morphological image processing, edge detection algorithm, histogram and histogram equalization; Motion detection algorithm; Circular Hough transforms.

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 devices and components, PCB design aspects; IGBT/MOSFET gate charge measurement; Design of gate driver circuit; Simulation of buck/boost converter and experimental verification; Full bridge and 3-phase inverter with load; Flyback and forward converter; V/f control of induction motor.

ENG(CEERI) : 2-222 : Unit Processes in Semiconductor Technologies : 3-0-0-3

Course Coordinator : G. Eranna

Crystal growth techniques, wafer preparation and shaping, chemical cleaning, thermal oxidation, photo-lithography, chemical etching (wet and dry), chemical vapor deposition techniques, thermal diffusion, ion implantation, metalization, chemical mechanical polishing, rapid thermal processing.

ENG(CEERI) : 2-223 : CMOS Digital VLSI Design : 3-0-0-3

Course Coordinator : A. Karmakar and J. G. Pandey

MOS Capacitor: energy-band diagram, C-V curve, accumulation, depletion and inversion regions; MOS transistor: threshold voltage computation, body effect, channel length modulation, current equation; NMOS/pseudo-NMOS/CMOS inverters and their analysis, static and switching characteristics; CMOS processing technology, layout design rules and technology interfaces, layer properties, parasitic and delay estimation; Layout of CMOS inverter and basic gates; CMOS latch-up; Combinational MOS logic circuits; Pass transistor and transmission gate based logic circuits; Dynamic logic circuits; Sequential logic circuits; Latches, D F/F; Clocking issues; Programmable Logic, PLA/PLD, memories; VLSI subsystem design strategies: structure, hierarchy, regularity, modularity; Various adder architectures: ripple carry adder, carry look-ahead adder, carry select adder, carry save adder; Booth multiplier, array multiplier; Shift register; Parity generator; Barrel shifter; State machines and controller design; Trends in VLSI design.

ENG(CEERI) : 2-225 : Semiconductor Processing Technologies Laboratory : 0-0-4-2

Course Coordinator : G. Eranna

Laboratory practices and safety considerations; Wafer preparation and shaping; Chemical cleaning; Thermal oxidation, photo-lithography; Wet chemical etching; Dry etching; Chemical vapor deposition; Thermal diffusion; Ion implantation; Metalization.

ENG(CEERI) : 2-226 : CMOS-based Physical Design Laboratory : 0-0-4-2

Course Coordinator : A. Karmakar and A. K. Saini

Laboratory practices and safety considerations; Overview of the laboratory toolset environment; Schematic editor; SPICE/Spectre simulation; Layout editor; Extraction, DRC and LVS tools; Transfer and output characteristics of NMOS transistor, parameter variations; CMOS inverter design and layout; Layout versus schematic (LVS), circuit simulation and layout of basic gates, D latch, D flip-flop, and adders; VLSI subsystem design mini-project.

List of Faculty Members : Advanced Electronic Systems

S. No.	Name	Designation	Discipline
1.	Dr. Chandra Shekhar	Director	Microelectronics/VLSI System Design
2.	Sh. Rahul Varma	Chief Scientist	Power Electronics and AC/DC Drives
3.	Sh. Raj Singh	Chief Scientist	Microelectronics/VLSI System 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. Saikrishna	Scientist	Electronic Instrumentation
13.	Sh. H. D. Sharma	Scientist	Mechatronics/Embedded Systems
14.	Sh. Pramod Tanwar	Scientist	Digital Systems/Embedded Systems
15.	Dr. B. A. Botre	Scientist	Instrumentation/Embedded Systems
16.	Sh. Santosh Kumar	Scientist	Electronic Instrumentation
17.	Dr. A. S. V. Sarma	Chief Scientist	Electronic Instrumentation (<i>Chennai Centre</i>)
18.	Dr. A. Gopal	Sr. Princ. Sc.	Electronic Instrumentation (<i>Chennai Centre</i>)
19.	Dr. R. Govindraj	Princ. Sc.	Electronic Instrumentation (<i>Chennai Centre</i>)