School of Physics, University of Hyderabad

Electronics Programme

The Electronics Programme was established at the School of Physics in 1995 at the initiative of University Grants Commission and the (then) Department of Electronics to promote research and teaching in electronic device research. The teaching programmes are reviewed every 5 years and have evolved from M.Sc. (electronics) (2-year programme) to M.Sc. (Tech.) (3-year programme) to the present 2-year M.Tech. programme in Integrated Circuit Technology. Research grade facilities have been established by the faculty for high quality R&D activities in Electronics Science. The M.Tech. (Integrated Circuit Technology) and the Ph.D. (Electronics Science) programme, begun in 2004, are described below:

1. M.Tech (Integrated Circuit Technology) of 4 Semesters Duration

Objectives of the M. Tech. (ICT) program: The rapid growth of the integrated circuit (IC) industry has led to the emergence of microelectronics process engineering as a new discipline. There is a need to impart quality education at a sufficiently advanced level in this discipline. A few IIT's and other engineering colleges have M. Tech. programs in this area. They are not only far too few, but also tend to be too specialized, focusing either on IC design or on micro-electronic fabrication only. It was therefore felt that there is a need to have a program that covers both these aspects. In addition, numerical simulation techniques are fast emerging as important tools to reduce the efforts and costs involved in fine-tuning the processes and circuits and they form an integral part of the design and development. The M. Tech. (ICT) program is designed to encompass all these aspects, *viz.*, design, simulation and fabrication and all types of IC's. It is expected that, after undergoing this program, the student will acquire both theoretical knowledge and practical skills in these three areas of IC technology and will be able to get into any one of these areas or be a bridge between these three important areas.

Eligibility: Candidates with BE or B.Tech in Electronics & Communications or Instrumentation, M.Sc. (Electronics), M.Sc. (Physics) are eligible for this course.

Selection: The students are selected through an All India entrance examination (GATE) followed by an interview.

Sponsored seats: Upto 8 seats are available on a supernumerary basis to permanent scientific staff from DRDO, ISRO and DAE affiliated organizations. Applicants under this category are exempt from the All India Entrance Examination. All other conditions for admission remain the same. The applicants will have to obtain appropriate sponsorship (fees and leave) from their parent organizations. The applicants can carry out their one-year project work at their parent institutions if they have appropriate facilities to carry out R&D in the areas relevant to the M.Tech. Programme.

Please see the sections on admissions information in the Brochure put out by the office of the Controller of Examinations for forms and schedules

ABOUT THE COURSE:

The first year is devoted to the course work and the second year is devoted to project work. The coursework covers all the three aspects of IC Technology, viz.

(1) Digital System Design
(2) RF and Microwave IC Design, Simulation and Testing
(3) Device Physics & Fabrication

The following is the Course Structure:

Semester I			**Total No. of Credits : 24**
Course No.	Title of the course	Contact Hours	Credits
IC101	Semiconductor Device Physics	4	4
IC102	Integrated Circuit & Nano Fabrication Technology	4	4
IC103	VLSI Design Technology	4	4

IC104	RF/Microwave IC's	4	4
IC105	Semiconductor Processing and Characterization Laboratory	6	3
IC106	VLSI Design Tech. Laboratory	6	3
IC107	RF/Microwave IC Laboratory	4	2
Semester II			**Total No. of Credits : 24**
Course No.	Title of the course	Contact Hours	Credits
IC201	Process, Device and Circuit Modeling and Analysis	4	4
IC202	MEMS Theory	2	2
IC203	Advanced Digital Design	4	4
IC204	VLSI Signal Processing	4	4
IC205	Integrated Circuit & Nano Fabrication Technology Laboratory	8	4
IC206	MEMS Laboratory	4	2
IC207	Advanced Digital Design Laboratory	8	4
Semester III			**Total No. of Credits : 22**
Course No.	Title of the course	Contact Hours	Credits
	Project Work+seminar		22
Semester IV			**Total No. of Credits : 22**
Course No.	Title of the course	Contact Hours	Credits
	Project Work +Dissertation+Viva	Semester	22

Digital System Design : This aspect of the course covers design and implementation of Digital VLSI Circuits and Systems, SoC design, DSP Systems (Algorithm and Architecture) and VLSI Physical Design. The laboratory courses are aligned with the respective theory courses covering the above aspects of Digital IC Design. In the Laboratory, the students are exposed to various EDA tools such as Riviera (Aldec), Synplify Pro, implementation of

designed systems using Xilinx ISE on FPGA development boards. The students are also trained in ASIC Design . Exposure to a hardware debugger (Chipscope Pro), SoC design using Xilinx EDK and Sysgen are included in this lab.

Device Physics & Fabrication: This part lays emphasis on providing knowledge on the basics of backend technology and deals with courses on Semiconductor Device Physics; IC Fabrication Processes; Device, Process and Circuit Simulation. A separate laboratory course in each of these subjects is part of the curriculum. The fabrication laboratory enables students to get hands-on experience on layout design using design rules, process steps such as photolithography, etching, thin film deposition, fabrication of MESFET/HEMT on multilayer GaAs wafers. The Semiconductor Device lab covers device characteristics, thin film deposition and characterization.

RF & Microwave IC Design, Simulation and Testing: This covers all high frequency aspects of device ,circuits and material characterization. The students get hands on training in design and

simulation of RF and Microwave circuits using Agilent's ADS tool. They also get exposed to Micro Electro Mechanical Systems (MEMS) device design and its applications in RF design area using COMSOL tool.

LABORATORY COURSES

The following laboratory courses are part of the M.Tech (ICT) programme:

VLSI DESIGN TECHNOLOGY/ADVANCED DIGITAL DESIGN:

In this lab students are exposed to different EDA tools to implement complete Digital/DSP systems on FPGA development boards and also exposed to ASIC design flow. The students also learn basics in System on Chip (SoC) design and its implementation using Xilinx tools.

Tools used: Rivera, Synplify Pro, Xilinx ISE, Synopsys, Xilinx EDK

RF & MICROWAVE IC DESIGN/MEMS

This lab trains the students to design and simulate circuits with both active and passive device components in the RF/Microwave frequency region. The students are encouraged to take up

mini projects to design, fabricate and characterize the circuits using Vector Network Analyzer. This lab also trains students in the emerging area Micro Electro Mechanical Systems (MEMS) and its applications in RF circuits

Tools used: Advanced Design System (ADS), COMSOL Multi physics 4.1

INTEGRATED CIRCUIT AND NANO-FABRICATION TECHNOLOGY:

The aim of this lab is to expose the students to device micro fabrication technology in general. Students will familiarize themselves with layout generation and micro-fab. They will then go through fabrication steps for device fabrication on GaAs wafers, in particular, those required to fabricate HEMT/ MESFET structure on multilayer GaAs wafers.

Equipment used: Scriber, Spin coater, Mask alignment and Exposure tool, Rapid Thermal Annealing system, Physical Vapour Deposition Systems, Surface Profiler, Wafer Prober, Device Analyser, ADS. Most of these equipments are housed, at present, in the Cleanroom at the Centre of Nanotechnology.

SEMICONDUCTOR DEVICE PHYSICS, NANO TECHNOLOGY, PROCESS, DEVICE AND CIRCUIT MODELLING & SIMULATION:

This lab deals with study of the characteristics and properties of semiconductor devices and materials. Basic experiments include the study of FETs, MOSFETs, Solar cells, Hall effect, Energy gap of semiconductors, metal thin film deposition by thermal evaporation, thereby students get hands on experience in thin film fabrication and characterization.

Equipment used: Thermal Evaporation system, Atomic Force Microscope, Surface Profilometer, Spectrophotometer.

The Simulation part of the lab deals with the modeling and simulation of fabrication processes, semiconductor devices and circuits.

Tools used: Silvaco Suite, SUPREM IV, MiniMOS, SPICE.

Projects:

The University is equipped to offer projects involving Digital Design with FPGA Implementation; Microwave Materials preparation and MEMS design; Device Microfabrication and processes development, sensors and, soon, MMIC fabrication. University's research facilities are, in general, open for the M.Tech. projects under certain conditions. Some of the facilities include Transmission Electron Microscoscope, Scanning

Electron Microscope, Electron Beam Lithography System, Scanning Near Field Optical Microscope, Network Analyser (to 40 GHz), etc. Students are also encouraged to carry out projects in related industries and R&D Laboratories under joint supervision of University and Industry faculties.

Typical Project titles in the last two years

1. SPICE simulation of MEMRISTOR and MEMRISTOR based circuits
2. Fabrication of an optical switch based on VO2 thin films.
3. Hardware Acceleration of DSP subsystems using FPGA.
4. FPGA implementation of cooperative spectrum sensing based on cyclostationary features for cognitive radio.
5. An Optimized Architecture and FPGA implementation of Motion compensation for H.264/AVC Base-line profile decoder.
6. Design and Analysis of MEMS based high-Q VHF disk resonator.
7. Realization of Class –A amplifier and analysis and design of class –E power amplifier.
8. Design and simulation of thin film bulk acoustic resonators and electrode effects.

Typical placement locations for students of this course.

Former students are working in companies such as IBM, Synopsys, Research Center Imarat, Thomson-CSF, BSNL. ADA Bangalore, BEL, DRDO, Airport Authority of India, Si2 Microsystems, Some of the students are registered for Ph.D in different premier Universities and R&D Institutes.

2. Ph.D. (Electronics Science) Programme

The Doctor of Philosophy in Electronics Science is awarded to candidates with aptitude for research and analytical skills who have contributed to advancement of knowledge in the area of Electronic Science. This programme covers, but is not restricted to, the areas of research in Micro-electronics, VLSI digital Design, Signal Processing, RF and Microwave materials, RF and Microwave circuits, Thin Films, MEMS. The qualifications are M.Sc. in Physics or Electronics or B.Tech./B.E. or M.Tech./M.E. in Electronics related subjects. The precise entry requirements and selection criteria for admission into the programme are specified in the admissions brochure.

The confirmation of Registration for the Ph.D. (Electronic Science) Programme requires completion of course requirements. At present, the course requirements are a minimum of 50% in Research Methodology and the following courses of the M.Tech. (Integrated Circuit Technology) Programme:

IC101	Semiconductor Device Physics
IC102	Integrated Circuit & Nano Fabrication Technology
IC103	VLSI Design Technology
IC104	RF/Microwave IC's

It is expected that Research Scholars enrolled in the programme will participate intensively in the creation/management of facilities and in running teaching laboratories. Research Scholars also have opportunities to take forward their innovative research into enterpreneurship.

Facilities available for research work are already listed above. The University along with DST has set up a Cleanroom with class 1000 and class 100 (ISO6 and ISO 5 areas) for Microfabrication work with electron beam lithography, at the Centre for Nanotechnology (CFN).