

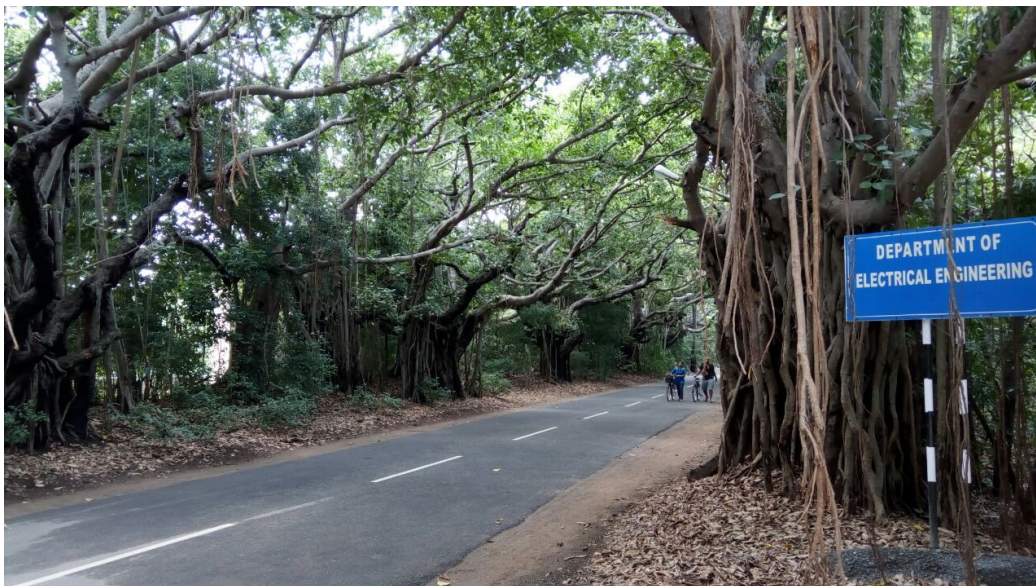
DEPARTMENT OF ELECTRICAL ENGINEERING

The Department of Electrical Engineering is one of the largest departments in IIT Madras which works in the frontier areas of communications, microgrids, integrated circuits and systems, microelectronics, electromagnetics and photonics, and biomedical devices. It works closely with industry, research labs, defense labs, hospitals and government. It counts several IEEE Fellows, Bhatnagar awardees, Swarna Jayanti awardees and editors of prestigious professional journals among its faculty. MTech students have exciting internship opportunities with both industries and universities in India and abroad and are often encouraged to upgrade to PhD. Their placement record is one of the best in IITM. Many have pursued higher studies at IITM or in other reputed institutions globally.

The department offers a M.Tech degree in Electrical Engineering.

Students are admitted into the following specializations:

1. [EE1: Communications and Signal Processing](#)
2. [EE2: Power Systems, Power Electronics and High Voltage](#)
3. [EE3: Microelectronics and VLSI Design](#)
4. [EE4: Control and Instrumentation](#)
5. [EE5: Microelectronics and Photonics](#)
6. [EE6: Integrated Circuits and Systems](#)



Detailed information about the Department's faculty, facilities, academic programs, publications, and related matters can be found on the website: www.ee.iitm.ac.in

Communications and Signal Processing (EE1)

Areas of research

Communications and Networks: Labs working in this group focus on current and cutting edge problems in wireless communications and networks. Their research focuses on mathematical modelling, analysis, designing of new algorithms and prototyping using test beds. Their interests span physical layer modulation and coding, scheduling and rate adaptation, estimation and detection, resource allocation and optimization, network control, information theory, 4G/5G technology and standards, LTE systems, MIMO systems, cognitive radios, mobile IP, optical backbone networks and software defined radios & networks.

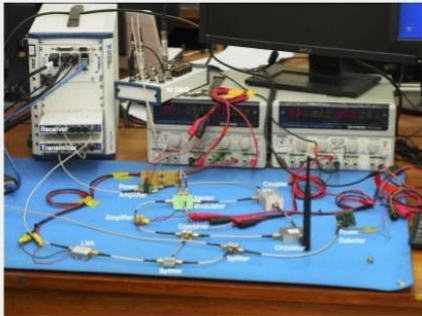
Image and speech signal processing: Labs working in image processing and computer vision focus on various aspects ranging from image deblurring and dehazing, underwater imaging, image and video matting, HDR to vision tasks like face recognition, 3D geometry inpainting and depth from motion blur. They also work on developing novel computational cameras and mathematical framework for their analysis as well as deep learning architectures for solving various image processing and computer vision problems. Speech group mainly works on the Automatic Speech Recognition (ASR) for indian language, deep learning methods for speech recognition and multilingual speech recognition.

About the programme

This Programme leads to specialization in modern communication system (with emphasis on broadband wireless communication), signal processing, optical and computer networks. Foundational graduate-level courses include probability and random processes, communication systems and digital signal processing. A number of advanced electives are available in the areas of digital communication, information theory, coding theory, wireless communications, speech & image signal processing, computational imaging, optical and data networks. Comprehensive laboratory training covers implementation on DSP processors & advanced wireline and wireless communications. The students opting for this Programme are expected to have good basic knowledge in the areas of analog & digital communications, signal processing. The mathematical backgrounds needed are (i) signals and systems (LTI systems and basic transform theory) and (ii) basic probability & random-processes.

Placements: Qualcomm, Intel, Samsung, Maxlinear, Sandisk, MediaTek, Redpine Signals, Analog Devices, TI, Cypress Semiconductor.

Research@ Communications and Networks



Software defined radio based experiment setup



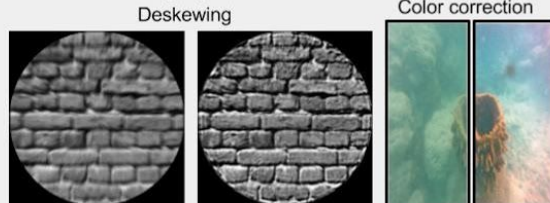
A prototype for in band full duplex radios using off the shelf RF components

Research@ Image Processing and Computer Vision Lab

Image enhancement:



Underwater imaging:



Motion Deblurring:

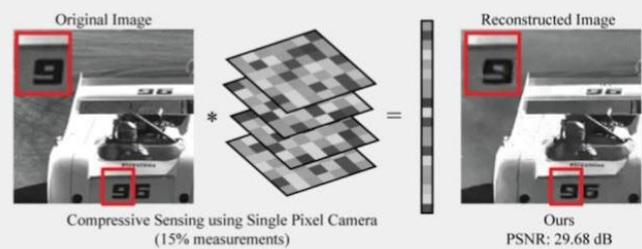


Deep learning: Motion segmentation



Research@ Computational Imaging Lab

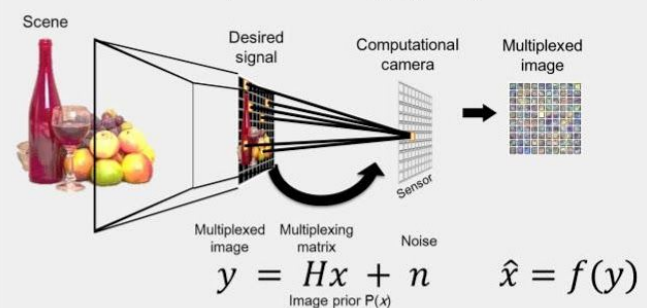
Deep learning for ill-posed signal recovery:



Novel imaging systems:



Framework for computational imaging analysis:



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Power Systems, Power Electronics and High Voltage (EE2)

Areas of research

The group is actively involved in research related to power electronics based motor drives, grid integration of renewable energy sources with a focus on solar and wind, power quality issues and mitigation techniques, smart grids, power systems modelling and analysis, energy markets, nanotechnology, condition monitoring of power apparatus adopting multi fusion sensor techniques, sterilization of liquid foods and effluent treatment.

About the programme

This programme leads to specialization in one or more of the following areas: Power electronics and machine drives, power systems and high voltage engineering. In the first semester students do courses in the areas of power electronics, power systems and machine drives. In the second semester, students can select a few elective courses from a large set which includes high voltage engineering for advanced knowledge in the area in the area of their interest.



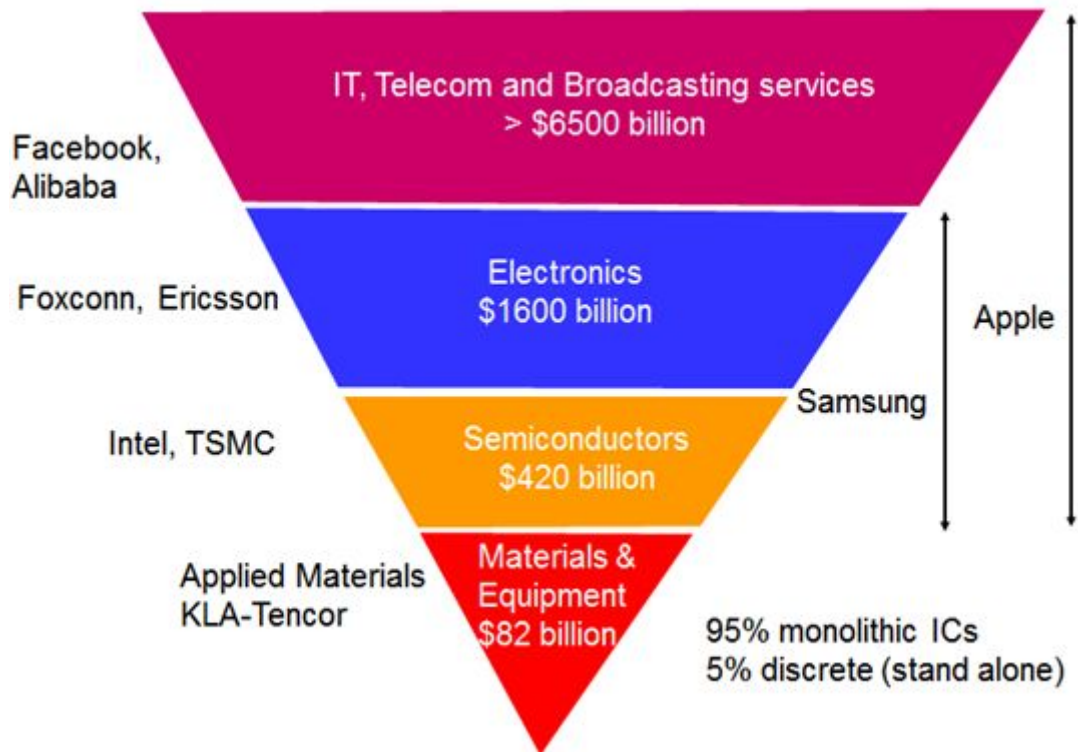
There are four important labs related to the programme: High voltage, electric machine, power quality and automation labs. High voltage lab is a state of art lab for condition monitoring of power apparatus and have capability to test power apparatus especially the lightning impulse voltage for 220 kV BIL. Machines lab has labview assisted facility for doing experiments on electric machines as well as power electronic drives. In power quality lab prototype power quality improvement devices are available. Automation lab has a scaled down model of power systems with SCADA. Software packages like ETAP, Power World Simulator, PSCAD, PSPICE, FEM are also available in these labs. A student is encouraged try his or her hand in all these labs. Further the student will get an opportunity to work in these labs basing on his/her interest during the project.

Placement: Some of the companies in which our students have been placed are: ***GE, Tata Motors, Lucas TVS, ABB, Honeywell, Eaton, Hitachi India Ltd., Tata Power, Alstom, Power Grid, L & T and Intel.***

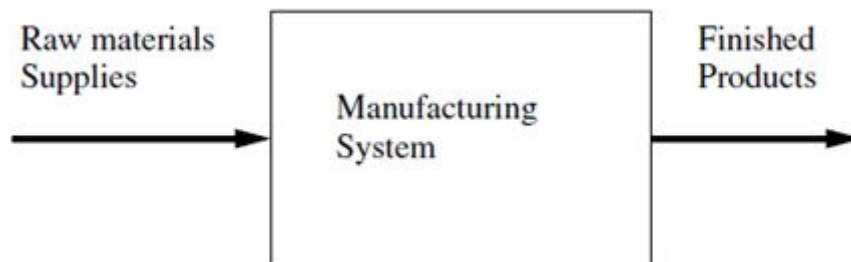
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Microelectronics and VLSI Design (EE3)

The goal of any technology is to create a useful product which is not readily available in nature by means of complex processing of material, information etc. Microelectronics is the science and technology of making very small electronic components and systems. In the last 60 years, microelectronic devices served as the foundation of the digital revolution which has affected all aspects of our modern life. Semiconductors can be considered as the brains of modern electronics, enabling advances in communications, computing, health care, defence, transportation, clean energy, and emerging technologies such as artificial intelligence (AI), virtual reality (VR), and the Internet of Things (IoT).



Global semiconductor industry is worth around \$420 billion (2017 figure). Integrated circuits (ICs) are sophisticated semiconductor products that often contain billions of transistors and perform high-level functions, while discrete devices often contain fewer transistors and perform simpler functions. 95% (by revenue) of all semiconductor products are sold in the form of integrated circuits.



The technology to fabricate these devices require a close collaboration of specialists from different disciplines and can be considered as a modern day alchemy which converts sand and other raw materials to a useful product like a microchip. These semiconductor products are used later by electronics market which is worth around \$1.6 trillion. Viewed from a systems-level perspective, semiconductor manufacturing intersects with nearly all IC process technologies, design, fabrication, integration, assembly, and reliability. The end result is an electronic component or system that meets all specified performance, quality, cost, reliability, and environmental requirements.

Although in the past personal computer market was the driver for semiconductor industry, the areas which have higher growth rates now are ICs for smartphones, ICs for autonomous and electric vehicles, sensors and actuators to enable IoT/ AI, solid state lighting and CMOS image sensors.

What we offer / What you learn

The M.Tech programme in Microelectronics and VLSI design is aimed at training students in design, simulation, modeling, fabrication and testing of very small electronic components and systems. Students are expected to undergo a broad set of core courses which cover the basics of all aspects of Microelectronics, VLSI design and MEMS and then given an opportunity to dive deep into any area by choosing suitable electives.

Core courses

EE5310 Analog Electronic Circuits

EE5311 Digital IC Design

EE5312 VLSI Technology

EE5313 Semiconductor Device Modeling

Elective courses

Materials and Devices	Circuits and Systems
EE5340 Microelectromechanical Systems	EE5130 Digital Signal Processing
EE5341 MOS Device modeling & Characterization	EE5320 Analog IC Design
EE5342 Compound Semiconductors	EE5323 Advanced Electrical Networks
EE5343 Solar Cell Device Physics and Material Tech	EE5325 VLSI Power Management Circuits
EE5345 Semiconductor Power Devices	EE5350 Linear Algebra for data analysis

EE5347 Electronic and Photonic Nano Devices	EE6320 RF Integrated Circuits
EE6346 Advanced CMOS devices & technology	EE6321 VLSI Data Conversion circuits
EE6500 Integrated Optoelectronic Devices	EE6322 VLSI Broadband Communication Circuits
EE5311 Introduction to Plastic Electronics	EE6361 Advanced topics in VLSI
EE6362 Advanced Topics in Microelectronics and MEMS	EE5331 DSP Architectures and Embedded Systems
EE6341 Compact Modeling of Devices for Integrated Circuit Design	EE5332 Mapping Signal Processing Algorithms to DSP Architectures
	EE6324 Phase Locked Loops
	EE6350 Analysis of Noise in Systems
	CS6330 Digital System Testing and Testable Design
	CS6230 CAD for VLSI

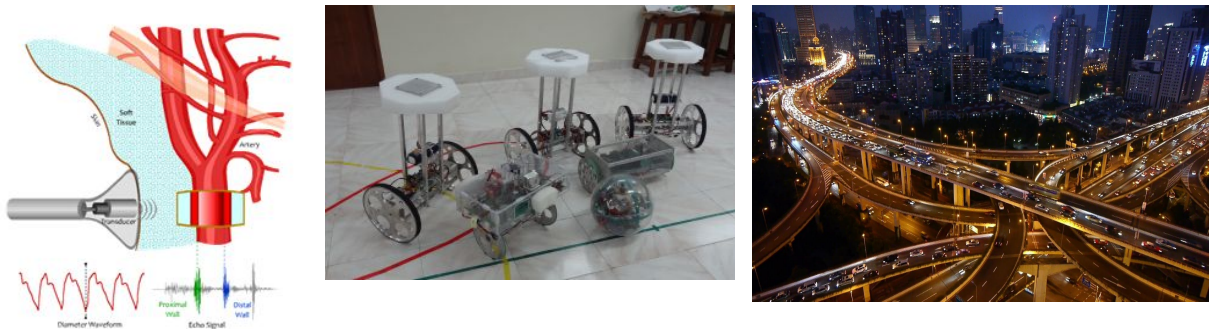
Students who join this program will have the opportunity to carry out their project work in labs that are equipped with the state-of-the-art design, simulation, fabrication and testing tools.

Placement: Some of the companies in which our students were placed are: Analog Devices, ARM, Cypress Semiconductor, GlobalFoundries, IBM, Intel, Texas Instruments, TSMC etc.

Control and Instrumentation (EE4)

What we do

Control and instrumentation lies at the heart of engineering. It is an important area of research for addressing the challenges and complexity of automation in industrial structures and manufacturing systems. Nowadays, diverse areas such as the energy systems, infrastructure management, transportation systems, and medicine are increasingly becoming reliant on progress in this discipline.



The research focus of the group spans a wide range. The recent efforts have been in modeling, design and control for intelligent robotics, biomedical instrumentation, healthcare, transportation and power networks, sensors for automotive and transport applications, and cyberphysical systems. Our research projects are funded by established organisations which include ***DST, DRDO, Nissan corporation, Emerson, ITRA and IU-ATC.***

What we offer

The M.Tech programme in Control and Instrumentation is aimed at training students in modelling, system analysis, controller design and instrumentation methods. The programme prepares engineers, with top-quality expertise and skills, for a key role in a wide range of high-tech engineering fields. The program has strong linkage with the Healthcare Technology Innovation Centre (www.htic.iitm.ac.in) operating out of IIT Madras Research Park. Students will have opportunities to work along with medical professionals and industry in developing technology solutions for unmet healthcare

needs of India. For more details about the programme refer our website (www.ee.iitm.ac.in/~dynamic_control/).

Where our graduates are placed

The graduates of our programme get placed in positions as design engineers and research staff members in leading public and private sector industries. These include *General Electric, Eaton, Honeywell, Schneider Electric, TVS Motors, Mathworks, Goldman Sachs, Amazon, Cypress Semiconductor, MaxLinear, Citycorp and Tiger Analytics.*

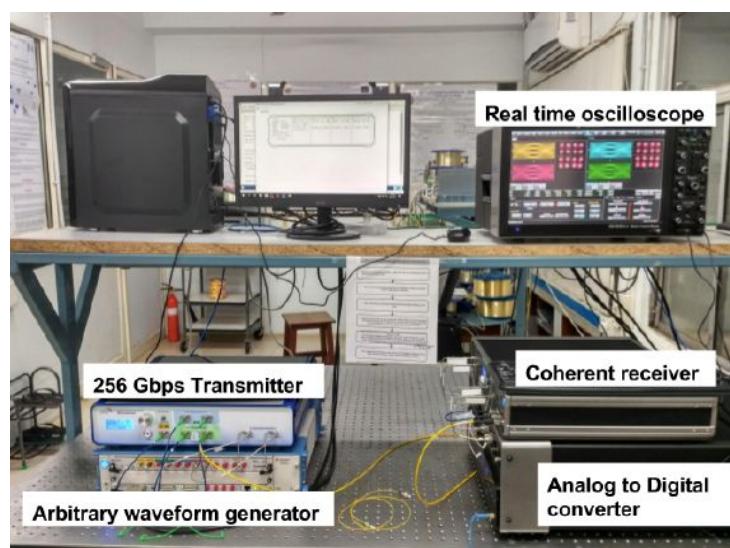
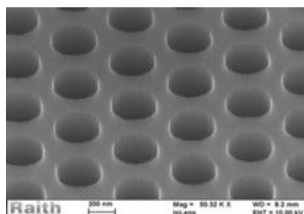
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Microelectronics and Photonics (EE5)

This M.Tech. program introduces basic knowledge of microelectronics and VLSI technologies along with in-depth know-hows of radio-frequency (RF) and lightwave technologies for communications, signal processing and sensing applications.

Photonic Crystal

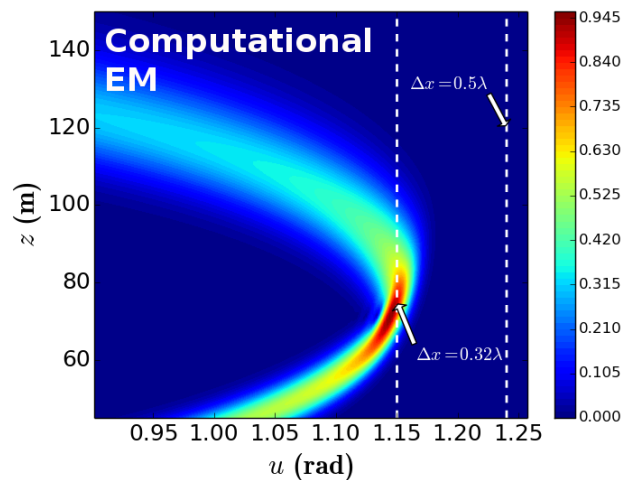


In the optical or photonics realm, we deal with various aspects of light, such as its generation, transmission, modulation, processing, switching, amplification, detection and sensing. Research activities include design, analysis and synthesis at the device, component, system, and network level. The group designs, fabricates, and analyses various kind of optoelectronic, plasmonic, and all-optical devices. In addition to physical devices, service layer related research on Tbps optical networks and quantum encryption are also investigated in such networks.

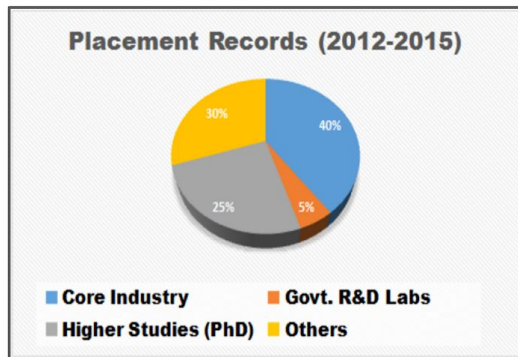


In the radio or microwave realm, we work on aspects of satellite remote sensing, inverse microwave imaging, computational electromagnetics, and millimeter wave communications for 5G networks.

Students who specialize in microelectronics and photonics typically get placed in top technical companies and government labs, while many choose to go on for doctoral studies. Some statistics can be seen in the infographic below.



PLACEMENT/EMPLOYERS



Sterlite Tech

VINVISH
Technologies Pvt. Ltd.
Defining Innovations

LVPEI
So that all may see
LV Prasad Eye Institute

JICA
SCIENCES

Mahindra

KLA Tencor

APPLIED MATERIALS
make possible

POWERGEAR
Experience The Power

DRDO

ISRO

TVS

TATA

GE

intel

ISRO

EATON

This is an interdisciplinary specialization, with the active support of faculty from Departments of Electrical Engineering, Physics, Applied Mechanics, and Engineering Design. The curriculum for the Photonics Programme can be found at

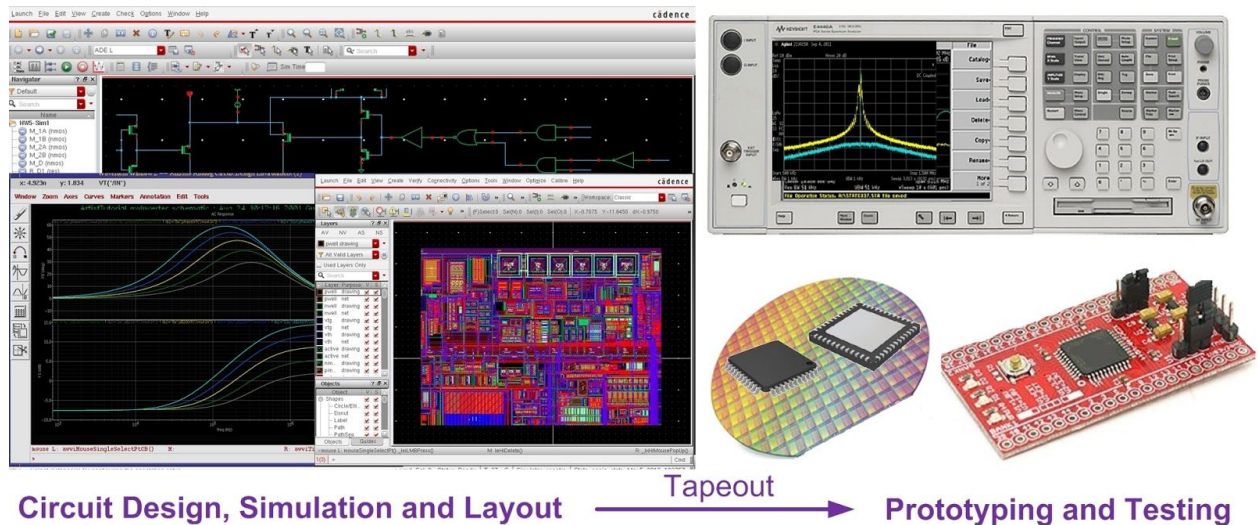
<http://www.ee.iitm.ac.in/pgpgm-rf-and-photonics>

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Integrated Circuits and Systems-iCS (EE6)

iCS

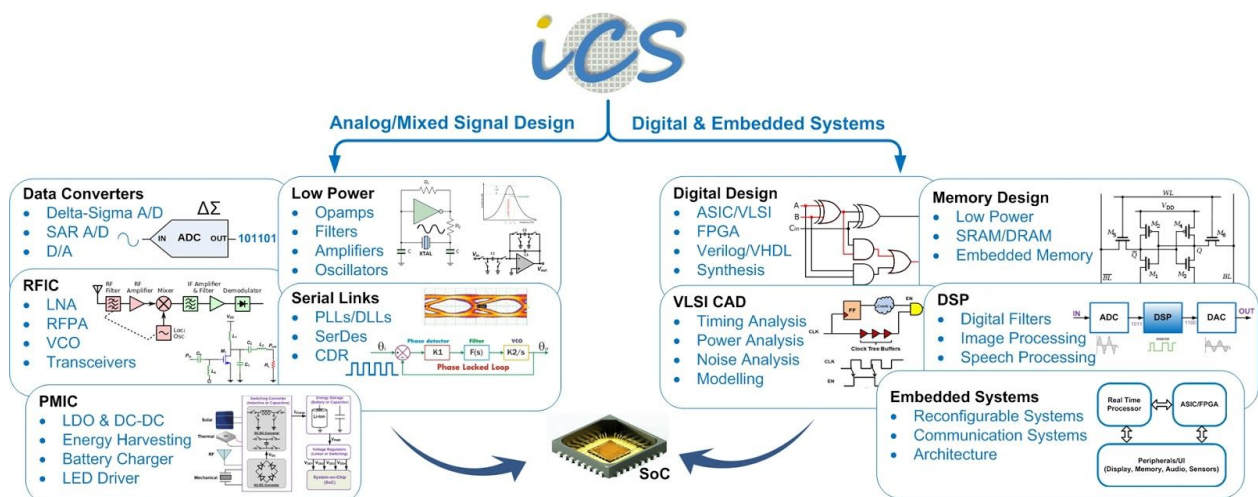
The Integrated Circuits and Systems (iCS) group at the department of EE, IIT Madras deals with various aspects of designing integrated circuits and embedded systems. The group has highly experienced faculty in the area of analog/mixed signal and digital ICs, VLSI CAD and embedded systems with track record of driving full chip products right from concept to design, tapeout, prototyping and testing.



Integrated Circuit Design Flow

Research Areas

Research in the iCS group is focused on design of various analog/mixed signal, VLSI CAD, digital circuits and embedded systems which are essentially required to build a complete system-on-chip (SoC). Our research work is published in renowned journals/conferences and also protected through patents.

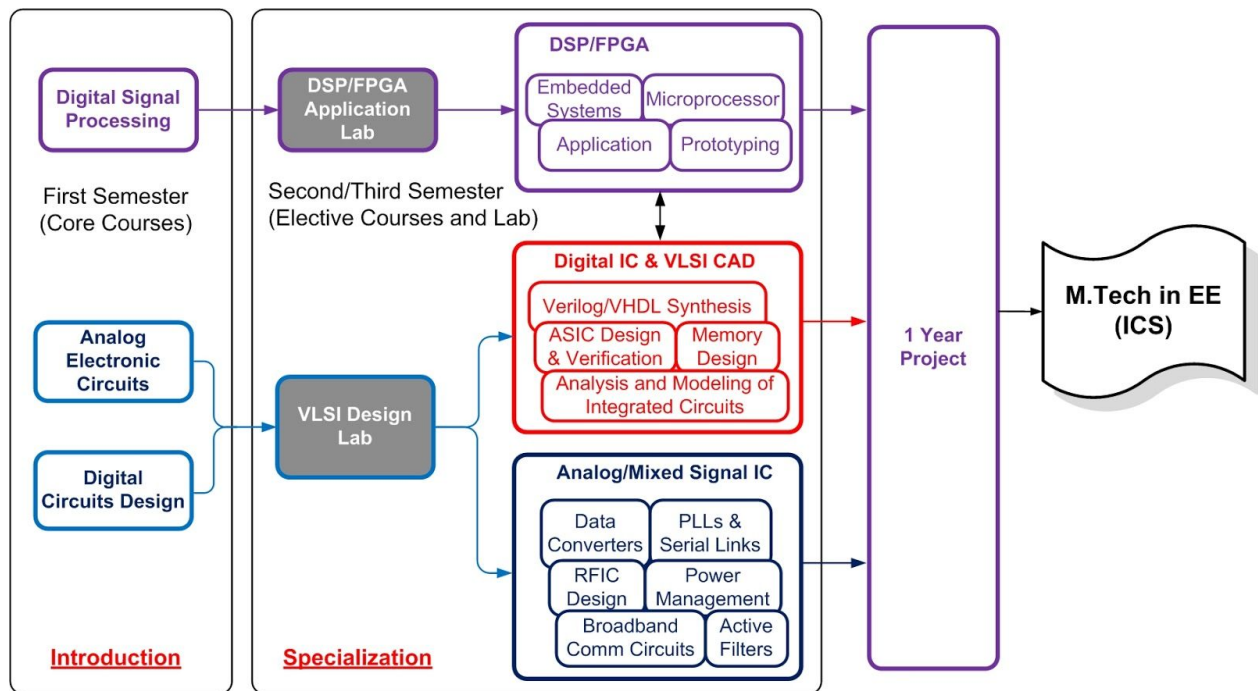


Research in iCS

MTech Program

MTech in EE in the iCS stream is an industry oriented program specially designed for students who want to pursue their careers in the area of IC design/VLSI or embedded systems. The program is structured to enable the students to learn basics of circuit design in the first semester and then take specialized courses and labs in the second semester. Students can choose the courses as per their area of interest which could be

analog/mixed signal ICs, digital ICs, VLSI CAD or embedded systems. The program also provides hands-on experience through a 1 year project where students go through the complete flow of designing an integrated circuit or a system.



MTech in EE with iCS stream

Placement

Needless to say, our students are in great demand in industry. Following are some of the leading companies where our students have been placed in recent times. Those interested in higher education have found PhD positions with reputed groups in India and abroad.



Further details about the iCS group and academic programs can be found at:

<http://www.ee.iitm.ac.in/ics>

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