MS Program in Embedded Systems Design with specialization in Smart Card Technology

Course Structure

	Code	Course Name	Credits*
BRIDGE	ESD001	Computer Architecture	
	ESD003	Introduction to Programming Languages	
	MVD002	Introduction to Logic Design	
	NTC002	Computer Networks	
FOUNDATION	ESD501	Analog and Digital Systems Design	3
	ESD502	Micro Computer Based System Design	3
	ESD504	Advanced C Programming	3
	ESD505	Theory of Operating Systems	3
	ESD506	Seminar Series – I	1
	ACT507	Java Programming – I	2
	AST602	Object oriented Analysis and Design Using UML	3
CORE	ESD601	Embedded Systems Design	3
	ESD602	Real-Time Operating Systems	3
	ESD603	Embedded Design Cycle	2
	SCT601	Smart Cards – I Physical Design & Systems Software	3
	NTC601	Wireless Communication	3
ADVANCED	ESD701	Advanced Micro-Controller Based System Design	3
	ESD703	Seminar Series – II	1
	ESD704	Tech & IP Management	1
	SCT702	Introduction to Cryptography	2
	SCT703	Smart Card – II Application Software	3
ELECTIVES	**Select suitable subjects of total 10 Credits**		
	ESD802	Embedded Communication Systems	3
	ESD805	Research Study	2
	ESD702	Embedded Multimedia Technology	3
	SCT704	RFID Architecture and Applications	2
	SCT705	Software Engineering and Project Management	3
		Elective(s) from MBAP-TCM	Max 6
PROJECT	ESD901	Mini Project	2
	ESD902	Project	18

** 1 Credit Hr = 16 Class Hrs / 32 Lab Hrs in a semester.*

SCHOOL OF INFORMATION TECHNOLOGY

MS Program in Embedded Systems Design
with specialization in
Automation and Control Systems
In Association with ESIGELEC, France

"We believe that wireless network embedded systems represent the infrastructure of the future, in that they will be used to monitor and control a number of physical infrastructures such as electric power, water, communications, oil and gas, and chemical refineries."

- Prof. S. Shankar Sastry,
University of California, Berkeley.

Automation and control is not a new concept; the area is receiving periodic spurts of development and the most recent one has come from the developments in embedded systems. Thinking of automation is exciting, working on automation is fun and safe and stable implementation is a challenge. The well established areas of automation are process control and industrial automation and the newer areas are intelligent or smart homes, automated robotic vehicle plants, driverless taxis, guided missiles, auto answering machines, ATM machines, and the like. The idea is to make the systems more and more smart and secure. Design of automation and control systems involves smart integration of advanced controllers, networking and communication standards with latest developments in software technology. Another development is happening with the miniaturization of devices leading to deployment in multiple locations and communicating to each other. Distributed control and automation systems are present in multiple application areas including automotive, industrial automation and avionics, the role of embedded systems that can communicate to each other has become the central point in the design. Present curriculum provides a unified learning methodology to understand the end-to-end solutions in this emerging technology of embedded automation and control systems.

Program

This four-semester, 24-months, full-time MS program in Embedded Systems Design with specialization in Automation and Control Systems in collaboration with ESIGELEC, France is designed to equip the students to gain industry oriented technical knowledge and also imparts hardcore skills in the high-end technologies incorporated in the area related to embedded control systems. This curriculum starts with introductory concepts in conventional control & instrumentation, and incorporates an essential knowledge base of computer control through hardware and software co-design along with application specific embedded control system design concepts. Electives related to Embedded Automation and Control has been introduced to prepare students in this emerging area.

Program Structure

- 72 Credits required for successful completion. Project work of 18 Credits incorporated in the last trimester to bridge the gap between theory and practice. Curriculum categorized into six levels of increasing complexity and corporate readiness: Basic, Foundation, Core, Advanced, Electives and Project.
- As an option to the advanced courses of this program, a student can take total 9 Credits courses from any other suitable MS Program provided they are fit for such courses.
- The student has to carry out at least one mini project in the specified trimester to consolidate the technical knowledge in selected specialization stream.
- Students are required to take four electives from the elective courses listed.
- To be eligible for MSP-ESD, a student has to take minimum subjects worth 63 Credits from this stream out of 72 Credits.

Program Pedagogy

All courses are designed to address the key areas of theoretical foundation, practical relevance and real life problem solving approach. To achieve this, the courses will be delivered by the use of collaborative learning processes through class room lectures, laboratory sessions, assignments, student seminars, and lectures by industry experts, case studies, relevant industry visits and research / industry projects.

Distinctive Features

- Exposure to state-of-the-art micro-controllers, digital signal processors and programmable logic arrays in the laboratories
- Coverage of all the above three embedded system domains.
- Development experience in real environment.
- Automotive Application specific course design
- Flexibility in the choice of project domain related to automotives
- A choice of research or automotive industry project

Eligibility

Graduates with at least a Bachelors Degree, and a minimum of 4 years study in Electrical / Instrumentation / Electronics / Communication / Information Technology / Computer Science or equivalent. Proficiency in C, C++ and Java is desired.

Program Commencement

The program commences in July / October.

Selection Process

The selection of an applicant for the course is based on the following:

- Application forms shall be scrutinized for academic profile in line with the eligibility criteria.
- Scores received at the Graduation level like BE / B Tech / M.Sc (Electronics) or equivalent.
- Scores received at the "Accepted Qualifying Examinations" like GRE / GATE & Performance in the Entrance Test
- Personal Interview

Evaluation and Certification

- Continuous evaluation and performance improvement program. Course-wise credits
- Balanced assessment based on internals, mid-term, laboratory and final theory examinations and project
- Detailed transcripts along with certificate

Placement Assistance

- Career guidance at the institute.
- Pre-placement facilitation/development and campus interviews by leading industries.
- Active interface with technology and user

companies.

Basic Courses

COM001: LIFE SKILLS DEVELOPMENT
This basic course prepares students for the rigors of the master's level program and professional careers that will follow. The course is divided into 9 sections that will be conducted throughout the program. The course stresses on: communication and presentation, leadership development, working in teams, time management, negotiation skills, and stress management through yoga, multicultural and diversity management and offsite experiential learning. The ultimate objective of this course is to develop individuals with high intelligence, emotional and spiritual quotients (IQ, EQ and SQ).

COM002: FOREIGN LANGUAGE (LEVEL 1)
In order to equip students to take up global careers, a choice of a foreign language as a major subject is offered. Medium of instruction is English.

Bridge Courses

Keeping in view the diverse background of students, variety of bridge courses are offered to attain the requisite level of competency for further learning. Students will undergo an entrance examination and an interview as a part of selection process. Depending on the performance, students will be advised to undergo bridge courses. Duration of the bridge courses is 4 weeks prior to the beginning of the academic term. Performance in the bridge courses count towards partial weightage in the relevant foundation courses.

ESD001: COMPUTER ARCHITECTURE
This course focuses on the study of the hardware structure of computer systems and sub-systems. The topics included are processor architecture parallelism and pipelining, cache and memory organization, I/O controllers and interconnection structures.

ESD002: SIGNALS AND SYSTEMS
This course deals with the representation of signals and systems, system properties, mathematical models of continuous-time and discrete-time signals and systems, time-domain and frequency domain concepts, sampling, Laplace and z-transforms, transfer functions and frequency response, convolution, stability, Fourier series and Fourier transform, probability and description of random signals.

ESD003: INTRODUCTION TO PROGRAMMING LANGUAGES
This course deals with the programming aspects of C, C++ and Java at the introductory level. Topics include basic data types, constants, variables and simple library/user defined functions and header files. Compilers, linkers and other utilities will be discussed with different variants. It also includes in-class demonstrations of problems solved in all three languages.

MVD002: INTRODUCTION TO LOGIC DESIGN
This course covers binary and non-binary systems, Boolean algebra, digital design techniques, logic gates, combinational circuits, K maps, flip-flops, sequential circuits and state machine theory. This course also includes preliminary timing analysis, digital circuit building blocks such as multiplexes, decoders, counters, PLA, PAL, PLD, various logic families, I/O standards, bipolar based logic; ECL, Bi-CMOS, memory; SRAM, DRAM, EEPROM, and I/O circuits.

NTC002: COMPUTER NETWORKS
This course shall emphasis on developing an understanding of the underlying principles of computer networking. Students will learn fundamental concepts of communication protocol stacks: OSI and TCP/IP, IP addressing schemes, subneting, LAN, MAN, WAN fundamentals, circuit and packets switching, networking devices, network protocols, standards, internet, intranet, network security and allied technologies.

Foundation Courses

ACS501: CONCEPTS OF INSTRUMENTATION (3 Credits T=2 L=1)
Characteristics of measurement system, basic sensors and transducers: pressure, temperature, level, bioelectric and the like. Signal conditioning for sensors, measuring & indicating instruments, control system basics, PID controllers, control loops –case studies.

ACS502: DIGITAL CONTROL THEORY (3 Credits T=2 L=1)
Introduction, signal processing in digital control, models of digital control devices and systems, design of control algorithms, state variable analysis of digital control systems, digital control systems with state feedback, dead-beat control by state feedback and dead-beat observers, Lyapunov stability of digital control system.

ESD502: MICROCOMPUTER BASED SYSTEM DESIGN (3 Credits T=2 L=1)
This course is designed to introduce 8-bit micro- controllers and also covers RISC/ CISC, Harvard/ Princeton architectures, timers/ counters, UART, SPI, PWM, WDT, input capture, output compare modes, I2C, interfacing LED, switches, ADC, DAC, LCD, RTC, types of memories, programming in assembly and C.

ESD504: ADVANCED C PROGRAMMING (3 Credits T=2 L=1)
This course is designed to address the more advanced use of C programming with standard C library functions, arrays, pointers, structures, unions, linked lists, trees, file handling, interrupts and macros. Lab sessions involve implementation of algorithms, review of common errors in C programming, to facilitate better debugging and analysis capabilities.

ESD505: THEORY OF OPERATING SYSTEM (3 Credits T=2 L=1)
This course covers operating system design concepts with examples from linux and windows operating system. The topics in operating system include: Operating system structures, process and thread management, memory management, virtual memory, file system, I/O subsystem and protection and security management.

ESD506: SEMINAR SERIES – I (1 Credit)
This course includes seminars by experts from industry and academia providing introduction to advances and possibilities in the advanced technology. Students are given a bird's eye view of multiple technological frontiers.

ACS503: FRENCH LANGUAGE –I (3 Credits)

Core Courses

ACS601: ADVANCED SENSORS AND ACTUATORS TECHNOLOGIES (2 Credits)
Conventional sensors classification & its physics, modern sensors: biosensors, chemical sensors, electromagnetism in sensing, smart sensors & TEDS, MEMS enabled sensors, micro sensor & actuator technology (MAT). Introduction to wireless sensor networks. Case studies: sensors in intelligent building, sensors in manufacturing industries.

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ACS602: VIRTUAL INSTRUMENTATION (3 Credits T=2 L=1)
Concepts of virtual instrumentation compared with classical instrumentation, the virtual instrumentation tools (hardware and software), learning of VI software, experimentation and mini project based on VI software.

ACS603: SEMINAR SERIES – II (1 Credit)
Students are required to present a seminar on relevant topics in embedded application domain for campus- wide audience.

ACS604: AUTOMATION AND CONTROL NETWORKS (3 Credits T=2 L=1)
Introduction and overview, system architecture, system elements, data communication links, software & algorithms in DCCS, reliability, applications, state of the art & future trends. Real-time communication architectures. Temporal properties of communication systems. Architectures for DCCS. Open and Heterogeneous DCCS. Specification and design methods for DCCS. System Issues. Performance issues and applications.

MVD601: ASIC MODELING (2 Credits T = 1 L= 1)
This course covers introduction to VHDL / Verilog history, importance & capabilities and synthesis issues. Gives insight understanding the basic construction & mdeling features for VHDL/ Verilog. Study of different data types & operators associated VHDL/ Verilog language. Implement state machine and sequential & combinational circuits. Introduces different packages & libraries available in VHDL. Writing efficient test bench.

Advanced Courses

ESG701: EMC AND CONSTRAINTS (3 Credits)
The physical constraints for embedded electronics, Complements in high temperature electronics, Electromagnetic field and disturbance, and recommendations & rules for design.

ESG702: EMBEDDED LINUX (3 Credits)
Generic architecture of an embedded linux system, linux architecture overview, thread and process context, context switching, process management, boot loaders, memory management, file systems, kernel module, basics for writing device driver, system calls handler and service routines, general purpose networking and porting linux over target. This syllabus is subject to change.

ESG703 COMMUNICANT EMBEDDED SYSTEMS (3 Credits)
This course deals with communication beteen two embedded systems and interfacing issues of multiple embedded systems. This syllabus is subject to change.

ESG704: TRANSVERSAL CONFERENCES (3 Credits)
Automotive electronical systems, system on chip, configuration administration in automotive context , flexray communication bus, autosar for automotive software development.

ESG705: FRENCH LANGUAGE – II (5 Credits)

ESG706: RESEARCH STUDY (6 Credits)
The subject aims to impart detailed knowledge of a highly specialized topic within the field of embedded automation & control systems. The directed reading and independent research will involve an in-depth study of an advanced embedded technology and its application to embedded automation & control systems under the guidance of a faculty member. The directed reading subject will be chosen in consultation with a supervisor. Admission into the subject requires agreement by a proposed supervisor and submission of a proposal to the School (via the programme director) during the first two weeks of the semester in which the course will be taken.

Electives

ACS801: BIO-MEDICAL INSTRUMENTATION (3 Credits)
Basic concepts of medical instrumentation, basic sensor & principles, amplifiers & signal processing, origin of bio-potentials, bio-potential electrodes & amplifiers, blood pressure & sound, measurement of flow and volume of blood, measurement of the respiratory system, chemical bio-sensors, clinical laboratory instrumentation and electrical safety.

ACS802: ROBOTIC CONTROL SYSTEMS (3 Credits)
Basic concepts and tools for analysis, design, and control of robotic mechanisms. Topics covered include foundation of kinematics, kinematics of robotic mechanisms, control issues, 2D: Forward & inverse kinematics, Jacobians, independent joint control, dynamics, coupled control, LQR, DP, DDP, and force control. 3D: Representing orientations, kinematics. Modern control schemes

ELECTIVE(S) FROM EMBEDDED SYSTEMS DESIGN PROGRAM

ELECTIVE(S) FROM AUTOMOTIVE ENGINEERING PROGRAM

ELECTIVE(S) FROM MICROELECTRONICS & VLSI DESIGN PROGRAM

Project

ACS901: MINI PROJECT (2 Credits)
This module is designed to introduce the complete design cycle of software or hardware in the development of an embedded system. Students are expected to design an end-to-end embedded solution to a practical problem in a particular domain.

ACS902: PROJECT (15 Credits)
Students can take up an industry-sponsored project or a research based in-house project leading to Master's level competency. For industry-sponsored projects, the career management center facilitates interaction between students and the industry. Students are encouraged to work on projects that will enhance their understanding in certain technology domains in a real-life scenario. The research project includes researching on the given / chosen seminar topic that will generally be state-of-the-art in the field and then delivering the seminar to peers and faculty along with its documentation in the prescribed IEEE format. Following the seminar the student has to undertake a research project under the guidance of tenure track / visiting faculty / and industry experts. The research project has to be submitted in the form of a dissertation that will be examined by experts nominated by the institute. The research project is the culmination of the student's learning in the institute and is expected to be of high standards as demanded by the industry from time to time.

Total Course Credits: 72

NOTE: COM002 Foreign language is an independent certificate program, compulsory for all students.

MS Program in Embedded Systems Design
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Automation and Control Systems

Course Structure

	Code	Course Name	Credits*
BRIDGE	ESD001	Computer Architecture	
	ESD002	Signals & Systems	
	ESD003	Introduction to Programming Languages	
	MVD002	Introduction to Logic Design	
	NTC002	Computer Networks	
FOUNDATION	ACS501	Concepts of Instrumentation	3
	ACS502	Digital Control Theory	3
	ESD502	Microcomputer Based System Design	3
	ESD504	Advanced 'C' Programming	3
	ESD505	Theory of Operating System	3
	ESD506	Seminar Series - I	1
	ACS503	French Language -I	3
CORE	ACS601	Advanced sensors and Actuators Technologies	2
	ACS602	Virtual Instrumentation	3
	ACS603	Seminar Series - II	1
	ACS604	Automation and Control Networks	3
	MVD601	ASIC Modeling	2
	Elective-I		3
	Elective-II		3
ADVANCED	ESG701	EMC and Constraints	3
	ESG702	Embedded Linux	3
	ESG703	Communicant Embedded Systems	3
	ESG704	Transversal Conferences	3
	ESG705	French Language - II	5
	ESG706	Research Study	6
ELECTIVES	ACS801	Bio-Medical Instrumentation	3
	ACS802	Robotic Control Systems	3
	Elective(s) from Embedded Systems Design program		3
	Elective(s) from Automotive Engineering Program		3
	Elective(s) from Microelectronics & VLSI Design program		3
PROJECT	ACS901	Mini project	2
	ACS902	Final project	18

** 1 Credit Hr = 16 Class Hrs / 32 Lab Hrs in a semester*

SCHOOL OF INFORMATION TECHNOLOGY

MS Program in Microelectronics and VLSI Design

An inadequate number of skilled engineers, due to lack of specialised technical course, poses a big barrier to the growth of India's VLSI Design business.

- ISA Study report

Ever since the invention of the transistor and especially after the advent of integrated circuits, semiconductor devices have kept expanding their role in our lives. Highly integrated transistor circuits entertain us, keep track of our money, make our home appliances smart and keep us connected to our beloved ones. New applications are emerging in the areas of networking and communication, control and automation, manufacturing, automobile and transportation, power controls, E-learning, medicine, signal processing and system securities. For many years the celebrated silicon technology has known a virtually one-dimensional path of development: reducing the minimal size of lithographic features. But, beyond CMOS, after 2010 to 2014, there will be new material challenges hence new approaches will be needed to develop devices with new processes using new materials. Hence, new architectures and new circuits will be the key to success. It is anticipated that future ULSI chips will have "chessboard" architecture. "Active Packaging" is going to play important role in designing such architectures. Worldwide semiconductor revenue totaled $261.4 billion in 2006, an 11.3% increase from 2005 and revenue growth is expected to remain on track through 2007 with an estimated worldwide revenue increase of 12 percent. Indian market for analog IC's worth $221million in 2005 is set to cross $427 million by 2007. India is a growing market for electronic products and is expected to reach Rs.16, 45,116 crore ($363 billion) by 2015 growing at a CAGR of nearly 30 percent. There is a strong link between semiconductors and electronics, with chips driving the innovation in electronic equipment. The Philips, ST Microelectronics and Motorola alliance has opened a joint R&D center in France, dedicated to future generation of nanoelectronics and semiconductor manufacturing on 300mm silicon wafers. Huge investments, by the three partners and other leading semiconductor companies, in the facility and planning, will create a number of job opportunities in the region and worldwide. This has increased the need to focus on core competencies, which leads to advanced specialization in VLSI design service market. VLSI Design is coming up very strongly on the Indian horizons, due to less initial investment cost. Most of the VSLI giants now have their design centers in India. IC designing, IP and EDA services constitute a big chunk of the Indian semiconductor sector. With all the leading IC design companies opening their design centers in India, there are many job opportunities emerging out in the field of microelectronics and VLSI design. According to one survey done by TCS and IIT Mumbai, there is a demand of around 2500 master's level candidates per year in India to meet the challenges raised by state-of-the-art system-on-chip design for emerging applications. Companies with skills in analog, mixed signal and RF domains are comparatively less in number to the skills available in digital domain. A gap exists between demand and supply of skilled manpower in this area. Short-term six-month courses are not in a position to develop the required skill sets. Identifying this huge gap and studying the reasons for this gap, I^2IT has come-up with a unique program that can address all the issues in the field of microelectronics and VLSI design.

Program

It is a hard fact that we are at a turning point in the evolution of the giant semiconductor and VLSI design industry. The program is exactly designed to meet all the challenges in VLSI market. This four semester, 24 months program of 72 Credits is designed to equip students to understand and accept; design, development and testing responsibilities in integrated circuit design. The bridge course ensures that every student attain the level of competency for further learning. The foundation course gives students a broad background in fundamentals with preliminary system design knowledge. Core and advanced course provides further in depth knowledge including: Fabrication technology, ASIC modeling, Layout synthesis, ASIC Design Flow, Testing and a mini project using basic VLSI design tools. Specialization courses and main project focus on implementation of VLSI design flow using state-of-the art CAD tools in low power, mixed signal and RF IC design.

Program Structure

- Successful completion requires minimum 72 credits.
- To bridge the gap between theory and practice project work worth 18 credits in the last semester.
- The entire curriculum is distributed over six levels, which are aimed at transcending the students' level of understanding for corporate readiness. The levels are respectively: Bridge, Foundation, Core, Advanced, Electives and Project.
- Student has to carry out one mini project in specified semester to consolidate the technical knowledge in the selected specialization stream.
- Students are expected to decide their specialization by choosing appropriate subjects from elective course.

Program Pedagogy

All courses are designed to address the key areas like theoretical foundation, practical relevance and the real life problem solving approach. To achieve that, courses will be delivered using collaborative learning process through class room lectures, laboratory sessions, assignments, student