

# Master of Science Program in Advanced IT (MSP-AIT)

With specialization in

Advanced Embedded Systems Design

Incorporating **Smart Card Technology**

*In association with Giesecke & Devrient, Germany*

*The key is making information as mobile as they are -- delivering it securely to mobile phones, pagers, PDAs, laptops and, often overlooked in discussions of mobility, stationary systems. Smart cards are at the center of this phenomenon.*

- Scott McNealy

Authenticity of individuals is becoming increasingly important for companies and government agencies involved in financial transactions, health care information, social security, secure data communications and wireless applications. Smart Cards play a major role in this development. Multiple corporate in India are establishing business verticals in smart card services. Government agencies are also actively preparing for Smart Card implementation in multiple areas. Trained manpower is a critical need for growth in this segment. This program has been designed with active support and participation from Giesecke & Devrient, a market leader in Smart Card Technology. The program provides a comprehensive foundation in this exciting technology and has been designed for the requirements of smart card manufacturers, service providers, and value added resellers.

## THE PROGRAM

This four-trimester, 18-month, full-time Masters Program in Advanced Embedded Systems Design 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 systems. This curriculum starts with introductory concepts in hardware and software, and incorporates an essential knowledge base of hardware and software co-design along with application specific embedded design concepts. Electives related to Smart Card Technology have been introduced to prepare students in this emerging area.

## PROGRAM STRUCTURE

- 60 Credits required for successful completion.
- Project work of 15 Credits incorporated in the last trimester to bridge the gap between theory and practice.
- Five levels of increasing complexity and corporate readiness: Basic, Foundation, Core, Concentration, Electives and Project.

- The student has to carry out at least one mini project in the specified trimester to consolidate the technical knowledge in selected specialization stream.

### 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-art laboratories for electronics, microcontroller, digital signal processors and smart cards design cycle
- Embedded development experience in real environment
- Coverage of design & development domains of smart card
- Application specific course design
- A choice of research or industry project

### ELIGIBILITY

Graduates with Bachelors Degree of minimum 4 years graduation with specialization in Electrical / Electronics / Communication / Information Technology / Computer Science or equivalent. Proficiency in 'C' and 'C++' language must be demonstrated to the selection panel.

### PROGRAM COMMENCEMENT

The program commences in June/ September/ January

### EVALUATION AND CERTIFICATION

- Continuous evaluation and performance improvement program. Course-wise Credits.
- Balanced assessment based on internals, mid-term test, 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.

### CURRICULUM

#### 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. German language is recommended. 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.

##### AST001: COMPUTER ARCHITECTURE

It focuses on the study of the hardware structure of computer systems and sub-systems. The topics in computer architecture include: 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 and stability issues. Fourier series and Fourier transforms.

##### MV003: 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 multiplexers, decoders, counters, PLA, PAL, PLD, various logic families, I/O



standards, bipolar based logic; ECL, BiCMOS, memory; SRAM, DRAM, EEPROM, and I/O circuits.

## FOUNDATION COURSES

### ESD501: ANALOG AND DIGITAL SYSTEMS DESIGN (3 Credits T=2 L=1)

This course covers digital circuit, CMOS logic circuits, combinational logic design, logic building blocks, idioms, and structured design, sequential logic design and timing analysis, clocks and synchronization, finite state machines, micro code control, digital system design, control and data path partitioning, designing digital and analog printed circuit boards.

### 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, emerging bus standards, types of memories, programming in assembly and C.

### ESD504: ADVANCED C PROGRAMMING (3 Credits T=2 L=1)

This course introduces the fundamentals of C programming, data structures, implementation of numerical algorithms, real-time concepts, and the use of macros. Lab sessions involving implementation of algorithms in C are included.

### ESD505: THEORY OF OPERATING SYSTEM (2 Credits T=1 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 device communication, and Protection and Security management.

### ESD506: ADVANCED TECHNOLOGY SEMINAR SERIES (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.

### AST 602: OBJECT-ORIENTED ANALYSIS AND DESIGN USING UML (3 Credits, T=2 L=1)

This course focuses on the major techniques of the Unified Modeling Language (UML), object-oriented analysis and design notation and how these techniques

can be applied to improve quality of productivity during the analysis and design of application. The topics covered include object models, analyzing system requirements, modeling concepts provided by UML, analysis and documentation of software designs using the unified process, identification of use cases, behavioral designs, design patterns to refine analysis and design models, implementation, testable and adaptable designs.

## CORE COURSES

### ESD601: EMBEDDED SYSTEMS DESIGN (3 Credits T=2 L=1)

This course covers the embedded system design issues, challenges and trends in embedded systems, assemblers, compilers, linkers, loaders, debuggers, profilers & test coverage tools, writing time and space sensitive programs.

### ESD602: REAL-TIME OS (3 Credits T=2 L=1)

This course covers the principles of real-time operating systems, design and implementation of real-time applications, real-time operating system development, operating system basics, hardware software features required for real time systems, process management, scheduling, inter-process communication and synchronization, memory management, virtual memory and distributed systems.

### ESD603: EMBEDDED DESIGN CYCLE (2 Credits)

This course introduces fundamental aspects of embedded systems design, implementation and testing, project management, hardware development life cycle, software development life cycle models, verification and validation process for complete embedded systems. Aspects of ISO/IEC/CE/ITU are covered.

### ESD606: TECHNOLOGY & IP MANAGEMENT (1 Credit)

This course provides an introduction to Indian and global IP practices with specific focus on embedded software. Case studies from different application disciplines are also presented.

### SCD01 SMART CARDS I PHYSICAL DESIGN & SYSTEMS SOFTWARE (2 Credits)

This course covers the Physical design of smart cards - Physical and electrical properties, Physical transmission of data, Micro-controllers and memory architectures for smart cards, Introduction to smart card operating systems, Features of smart card OS Encryption, Cryptography, Data compression, Data transmission protocols, Application programming interface (API for smart card OS).

**SNTW504: WIRELESS COMMUNICATIONS****(3 Credits)**

This course begins with discussion on antennas and propagation, spread spectrum theory, cellular mobile telephone architecture, characterization of wireless channel, including path loss for different environments, multi-path fading. It also covers modulation techniques and security for WLAN, WiMAX.

**CD901: MINI PROJECT (3 Credits)**

This course is designed to introduce the research topic choice for the student. At the end of the proposal stage, students are expected to propose and defend their project proposals. An internal faculty guides the project. The proposal has to be submitted in the form of a report including the detailed literature survey that will be examined by experts nominated by the institute.

**ADVANCED COURSES****ESD701: ADVANCED MICRO-CONTROLLER BASED SYSTEM DESIGN (3 Credits T=2 L=1)**

This course introduces 32-bit processors, ARM/ OMAP architecture and organization, ARM/ OMAP programming model, ARM - / OMAP instruction set, ARM/ OMAP exception handling, ARM / OMAP assembly and C programming.

**SCD02 INTRODUCTION TO CRYPTOGRAPHY****(2 Credits T=1, L=1)**

Introduction to Cryptography, Pseudo-Random numbers, Pseudo-Random number generators, Hashing, principle of encryption, Common encryption and decryption algorithms, Cryptography in e-business, encryption for wireless applications.

**SCD03 SMART CARDS II APPLICATION SOFTWARE****(3 Credits)**

This course covers smart card life cycle - Software development life cycle, Hardware design life cycle, Interleaving the hardware design and software design. Application design methodology, Quality assurance and testing - Standards compliance, ISO, IEC etc., Quality assurance vs. Quality control with respect to smart cards. Application domains case studies-Telecom, Payment systems, Terminals, Air transportation. Sample applications.

**SCD04: SOFTWARE ENGINEERING AND PROJECT MANAGEMENT (2 Credits, T=1 L=1)**

This course provides a comprehensive analysis of software engineering techniques and shows how they can be applied in practical software projects, all with an object-oriented approach. This course extensively covers software process technology, system integration, requirement management, software project

management, verification and validation, risk analysis, pattern based reuse, dependable systems development, distributed system engineering and legacy systems. This course covers SW reference and assessment models like CMMI and SPICE (ISO 15504) and ISO 12207 Quality Management according to ISO 9000

**ESD805: RESEARCH STUDY (3 Credits)**

The subject aims to impart detailed knowledge of a highly specialized topic within the field of embedded systems. The directed reading and independent research will involve an in-depth study of an advanced embedded technology and its application to embedded 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 program director) during the first two weeks of the semester in which the course will be taken.

**PROJECT****SCD902: PROJECT (15 Credits)**

Students can take up an industry-sponsored project or a research based in-house project leading to Post Diploma 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 involves work on a given/chosen seminar topic that will generally be state-of-the-art in the field. The student is then expected to deliver a seminar to peers and faculty along with relevant 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 at the institute and is expected to be of commensurately high standard.

**TOTAL COURSE CREDITS : 60**



# Course Structure



**PROJECT**      SCD902    15 Credits

<b>ADVANCED</b>	SCD02	Introduction To Cryptography	2
	SCD03	Smart Cards II Application Software	3
	ESD701	Advanced Micro-Controller Based System Design	3
	ESD805	Research Study	3
	SCD04	Software Engineering And Project Management	2



<b>CORE</b>	ESD601	Embedded Systems Design	3
	ESD602	Real-Time OS	3
	ESD603	Embedded Design Cycle	2
	ESD605	Technology & IP Management	1
	SCD01	Smart Cards I Physical Design & Systems Software	3
	NTW504	Wireless Communications	3
	SCD901	Mini Project	3



<b>FOUNDATION</b>	ESD501	Analog And Digital Systems Design	3
	ESD502	Micro Computer Based System Design	3
	ESD504	Advanced C Programming	3
	ESD505	Theory Of Operating System	2
	ESD506	Advanced Technology Seminar Series	1
	AST 602	Object-Oriented Analysis And Design Using UML	3



<b>BRIDGE</b>	MV003	Introduction To Logic Design	0
	AST001	Computer Architecture	0
	NTW002	Signals And Systems	0

Code	Course Name	Credits
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## AESD - SCT Laboratory Infrastructure

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Following tools demonstrates tools in Embedded Lab along with the links between different domains in embedded lab.

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### **MICROCONTROLLER EVALUATION & DEVELOPMENT KIT**

- AVR STK 500
- AVR Kits (AT Mega)
- AVR Emulator
- B051 Evaluation Kits
- Rabbit RCM 3720
- Rabbit RCM 2200
- ARM7TD Evaluation Board
- ARM9 Evaluation Board
- Intel Strong ARM SA1100 Evaluation

### **OS and RTOS**

- Linux
- RTLinux 2.2

### **DIGITAL SIGNAL PROCESSING**

- DSK 5510
- DSK 6711
- OMAP
- Code Compressor Studio2.1

### **TESTING & VERIFICATION TOOLS**

- PCLint
  - Universal Programmer
  - PC based Logic Analyzer
  - Function Generator (Scientific)
  - 100 MHz Dual channel DSO CRO
  - 200 MHz Four channel DSO CRO
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