

## BITS-Pilani, Hyderabad Campus: Course Description

### M.E. Microelectronics

*(Refer: Bulletin pages 205, 215 and 489)*

Year I	Semester I		Semester II	
	Course	Credits	Course	Credits
	MEL G611 IC Fabrication Technology	5	BITS G540 Research Practice	4
	MEL G621 VLSI Design	5	MEL G632 Analog IC Design	5
	MEL G631 Physics & Modeling of Microelectronic Devices	5	MEL G641 CAD for IC Design	5
	Elective 1	*	Elective 2	*
		<b>19</b>		<b>18</b>
Year II	Semester I		Semester II	
	Course	Credits	Course	Credits
	Elective 3	*	BITS G629T Dissertation	<b>16/20</b>
	Elective 4	*		
	Elective 5	*	BITS G639 Practice School	<b>16/20</b>
	Elective 6	*		
		<b>13</b>		<b>16/20</b>

#### Core Courses:

- MEL G611 IC Fabrication Technology
- MEL G621 VLSI Design
- MEL G631 Physics and Modelling of Microelectronic Devices
- MEL G632 Analog IC Design
- MEL G641 CAD for IC Design
- BITS G540 Research Practice

#### Electives (any six):

- BITS F415 Introduction to MEMS 3 1 4
- CS G553 Reconfigurable Computing 5
- CS G562 Advanced Architecture and Performance Evaluation 3 2 5
- CS G612 Fault Tolerant System Design 2 3 5
- EEE F434 Digital Signal Processing 3 1 4
- EEE G510 RF Microelectronics 5
- EEE G512 Embedded System Design 3 1 4
- EEE G522 Advanced Satellite Communication 5
- EEE G572 Digital Signal Processing 3 2 5
- EEE G594 Advanced VLSI Devices 5
- EEE G595 Nanoelectronics and Nanophotonics 5
- EEE G613 Advanced Digital Signal Processing 5
- EEE G626 Hardware Software Co-Design 4
- MEL G512 Optoelectronic Devices Circuits and Systems 3 2 5
- MEL G531 Testable Design and Fault Tolerant Computing 3 2 5
- MEL G612 Integrated Electronics Design 2 2 4
- MEL G622 Introduction to Artificial Neural networks 2 2 4
- MEL G623 Advanced VLSI Design 5
- MEL G624 Advanced VLSI Architectures 5
- MEL G625 Advanced Analog and Mixed Signal Design 5
- MEL G626 VLSI Test and Testability 5
- MEL G642 VLSI Architectures 2 2 4

## Core Courses:

### **MEL G611 IC Fabrication Technology**

**[3 2 5]**

Material properties; crystal growth and doping; diffusion; oxidation; epitaxy; ion implantation; deposition of films using CVD, LPCVD and sputtering techniques; wet and dry etching and cleaning; lithographic process; device and circuit fabrication; process modeling and simulation.

### **MEL G621 VLSI Design**

**[3 2 5]**

Introduction to NMOS and CMOS circuits; NMOS and CMOS processing technology; CMOS circuits and logic design; circuit characterization and performance estimation; structured design and testing; symbolic layout systems; CMOS subsystem design; system case studies.

### **MEL G631 Physics and Modelling of Microelectronic Devices**

**[3 2 5]**

Physics and properties of semiconductor - a review; pn junction diode; bipolar transistor; metal semiconductor contacts; JFET and MESFET; MOSFET and scaling; CCD and photonic devices.

### **MEL G632 Analog IC Design**

**[3 2 5]**

Basic concepts; BICMOS process and technology; current and voltage sources; differential and operational amplifiers; multipliers and modulators; phase-lock techniques; D-to-A and A-to-D converters; micropower circuits; high voltage circuits; radiation resistant circuits; filter design considerations.

### **MEL G641 CAD for IC Design**

**[3 2 5]**

Introduction to VLSI design methodologies and supporting CAD tool environment; overview of 'C', data structure, graphics and CIF; concepts, structures and algorithms of some of the following CAD tools; schematic editors; layout editors; module generators; silicon compilers; placement and routing tools; behavioural, functional, logic and circuit simulators; aids for test generation and testing.

### **BITS G540 Research Practice**

**[4]**

This course is designed to train the students towards acquiring competence in research methodologies. The course will be conducted in terms of actual participation in Research and Development Work. Each student will be assigned to a faculty member to work on specified projects. The student will be required to present a number of seminars in his research area in a structured manner.

## **Electives (any six):**

### **EA C415 Introduction to MEMS**

**[ 4\*]**

Overview, history and industry perspective; working principles; mechanics and dynamics, thermofluid engineering; scaling law; microactuators, microsensors and microelectro mechanical systems; microsystem design, modeling and simulation; materials; packaging; microfabrication: bulk, surface, LIGA etc; micromanufacturing; microfluidics; microrobotics; case studies.

### **CS G553 Reconfigurable Computing**

**[5]**

Overview of Programmable Logics. FPGA fabric architectures. Logic Elements and Switch Networks. Design and Synthesis of Combinational and Sequential Elements. Placement and Routing. Pipelining and other Design Methodologies. Fine-grained and Coarse-Grained FPGAs. Static and Dynamic Reconfiguration. Partitioning. Hardware/Software Portioning and Partial Evaluation. Systolic Architectures.

### **CS G562 Advanced Architecture and Performance Evaluation**

**[3 2 5]**

Introduction to advanced architectures; parallel processing; pipelining and vector processing; array processing; SIMD computers and processor enhancement; performance evaluation methods, statistics and discrete math applications; modelling for evaluation of virtual memory; time sharing environments.

### **CS G612 Fault Tolerant System Design**

**[2 3 5]**

Principles of fault tolerant systems, redundancy, parallel and shared resources, spatial systems, configurations, design aspects etc.

### **EEE F434 Digital Signal Processing**

**[3]**

Introduction; design of analog filters; design of digital filters: (IIR and FIR); structures for the realization of digital filters; random signals and random processes; linear estimation and prediction; Wiener filters; DSP processor architecture; DSP algorithms for different applications.

### **EEE G510 RF Microelectronics**

**[5]**

Introduction; application of RF electronics in modern systems; basic concepts in RF circuit design, active RF components: various RF diodes and transistors and their circuit models, matching and biasing networks, RF amplifier design: low power, low noise and broadband amplifiers, RF oscillator design; negative resistance oscillator; dielectric resonator oscillators, phase noise. RF Mixers: Balanced mixers; low noise mixers; noise in RF circuits, microwave transmitters and receivers.

### **EEE G512 Embedded System Design**

**[3 1 4]**

Introduction to embedded systems; embedded architectures: Architectures and programming of microcontrollers and DSPs. Embedded applications and technologies; power issues in system design; introduction to software and hardware co-design.

### **EEE G522 Advanced Satellite Communication**

**[5]**

Radio wave propagation effects, low, medium and geo-synchronous earth orbits and their main characteristics. Various sub-systems of the satellite, the outer space and its impact on the design

of spacecraft subsystems, LEO satellite network and its routing calls; Battery technology , propagation loss models, modulation and error correction techniques, Digital Video Applications, Satellite Mobile including N GEO, satellite access techniques, third generation satellite communication, remote sensing, bandwidth utilization and throughput capability, the Indian National Satellite System (INSAT), INTELSAT and other international satellite programs, VSAT, Mobile and Personal Satellite communication, principles of Global Positioning System (GPS), GPS receivers and its applications

### **EEE G572 Digital Signal Processing**

**[3]**

Introduction; design of analog filters; design of digital filters: (IIR and FIR); structures for the realization of digital filters; random signals and random processes; linear estimation and prediction; Wiener filters; DSP processor architecture; DSP algorithms for different applications.

### **MEL G623 Advanced VLSI Design**

**[5]**

Deep submicron device behavior and models, Interconnect modeling for parasitic estimation, Clock signals and system timing--Digital phase locked loop design, memory and array structures, Input/output circuits design, ASIC technology, FPGA technology, High speed arithmetic circuits design,-Parallel prefix computation, Logical effort in circuit design, Low power VLSI circuits- Adiabatic logic circuits, Multi threshold circuits, Digital BICMOS circuits, Design of VLSI systems.

### **EEE G595 Nanoelectronics and Nanophotonics Technology**

**[5]**

Semiconductor Fundamentals, Band Theory, Quantum Structures and Quantum Mechanics, Transport in Quantum Structures, Optical Properties of Semiconductor Quantum Structures, Strain Engineering, Electro- Optic Effects, Photonic / electronic Devices based on Nano structures.

### **EEE G613 Advanced Digital Signal Processing**

**[5]**

Review of stochastic processes, models and model classification, the identification problem, some field of applications, classical methods of identification of impulse response and transfer function models, model learning techniques, linear least square estimator, minimum variance algorithm, stochastic approximation method and maximum likelihood method, simultaneous state and parameter estimation of extended kalman-filter, non-linear identification, quasi linearization, numerical identification methods.

### **EEE G626 Hardware Software Co-Design**

**[4]**

FPGA and ASIC based design, Low-Power Techniques in RT Embedded Systems On-chip networking. Hardware Software partitioning and scheduling, Co-simulation, synthesis and verifications, Architecture mapping, HW-SW Interfaces and Re-configurable computing.

### **MEL G512 Optoelectronic Devices, Circuits & Systems**

**[3 2 5]**

Physics of optical radiation and principles of calculation in radiation physics & optics, fundamental laws of photometry. Interaction between optical radiation and matter. Radiation sources. Parameters of IR detectors and junction photodetectors, parameters common to emitters and receiver, radiation measurements, optoelectronic components, optoelectronic integrated devices, photodetector circuits, methods of modulation and optoelectronic system design and applications.

**MEL G531 Testable Design & Fault Tolerant Computing****[3 2 5]**

Fault: types, modelling and simulation; testing methodologies, coverage, economics and quality; test vector generation: design for testability, built-in self tests; fault tolerant computing; fault tolerant software.

**MEL G612 Integrated Electronics Systems Design****[2 2 4]**

General architectural features of 8/16/32 bit microprocessors, programmers model of 8086, assembly language programming, hardware design around 8086, bus based systems design, system design around IBM PC, design of real-time systems, ASIC's development tools.

**MEL G622 Introduction to Artificial Neural Networks****[2 2 4]**

Fundamentals and definitions; Perceptrons, backpropagation and counter propagation Networks; Statistical methods for network training; Hopfield nets; Associative memories; Optical neural networks; Applications of neural networks in speech processing, computer networks and visual processing.

**MEL G623 Advanced VLSI Design****[5]**

Deep submicron device behavior and models, Interconnect modeling for parasitic estimation, Clock signals and system timing--Digital phase locked loop design, memory and array structures, Input/output circuits design, ASIC technology, FPGA technology, High speed arithmetic circuits design,-Parallel prefix computation, Logical effort in circuit design, Low power VLSI circuits-Adiabatic logic circuits, Multi threshold circuits, Digital BICMOS circuits, Design of VLSI systems.

**MEL G624 Advanced VLSI Architectures****[5]**

Instruction set design and architecture of programmable DSP architectures; dedicated DSP architectures for filters and FFTs; DSP transformation and their use in DSP architecture design; Application Specific Instruction set Processor; superscalar and VLIW architectures.

**MEL G625 Advanced Analog and Mixed Signal Design****[5]**

Mixed signal blocks and design issues, Design of high speed comparators, opamps, Design of sample and hold circuits, Different architectures of analog to digital and digital to analog converters, Design of CMOS analog multipliers and dividers, Design of switched capacitor filters, Design of phase locked loop, Layout techniques for analog and mixed signal design, noise issues.

**MEL G626 VLSI Test and Testability****[5]**

Fault models and types; automated test generation for combinational logic; test generation for sequential logic; need for adding testability logic; design for testability; Adhoc DFT methods; structured DFT; test generation for delay fault; issues in analog circuit testing and testability.

**MEL G642 VLSI Architectures****[2 2 4]**

Overview of CISC processor architectures; Instruction set architecture of CISC processor; hardware flow-charting methods; implementing microprocessor logic from hard-ware flowcharts; RISC instruction set architecture; Pipelined execution of RISC instructions; pipeline execution unit design; control hazards; design of memory hierarchy.