THE UNIVERSITY OF WESTERN AUSTRALIA

FACULTY OF
Engineering, Computing
and Mathematics

SCHOOL OF ELECTRICAL, ELECTRONIC AND COMPUTER ENGINEERING (EECE)

Masters or Doctor of Engineering

Postgraduate Coursework Programmes

- *Information and Communications Technology*
- *Microelectronics*
- *Power Systems*

School of Electrical,
Electronic and Computer
Engineering (EECE)
THE UNIVERSITY OF WESTERN AUSTRALIA

Microelectronic

(MEME)

The field of Microelectronics encompasses a wide range of areas in which engineers are confronted by issues resulting from advances in computer, communications, defence and aerospace, and other rapidly developing areas. This masters programme will address a wide range of issues from VLSI system design, to realisation of integrated circuits, to semiconductor materials and device physics issues that directly affect device and system performance. The course will cover design techniques for both analogue and digital circuits, methods in the process of designing integrated circuits, device layout and device physics and technology.

The Master of Engineering in Microelectronics course offered by The School of Electrical, Electronic and Computer Engineering at The University of Western Australia has a focus on the key areas in this field in the context of modern microelectronics.

The duration of the Master of Engineering in Microelectronics course is 2 years (96 points). The course includes preparatory units, core units, electives and an individual research project.

The preparatory units will be determined by The School on the basis of the candidate's background and experience. For applicants with advanced standing in the field of microelectronics, credit for up to 48 points may be granted to allow direct entry into the advanced programme at ME level.

The advanced programme comprises 48 postgraduate points:

three 6-point core units

- Advanced Digital VLSI Design ELEC8320
- Analogue integrated circuit design ELEC8323
- VLSI Technology and Reliability ELEC8329

two 6-point electives (From the following):

- Advanced Microelectronics Topics 1 ELEC8321
- Advanced Microelectronics Topics 2 ELEC8322
- Compound Semiconductor Devices ELEC8324
- Design for Testability ELEC8325
- Micro-electro-mechanical systems ELEC8326
- Opto-electronic devices ELEC8327
- System-on-a-chip Design ELEC8328

plus a substantial 18-point individual research project in the field of microelectronics:

- Dissertation MEME ELEC8330 Part 1, ELEC8331 Part 2, ELEC8332 Part 3

The likely employment opportunities for graduates of this programme are in the microelectronics design and fabrication industry in Australia and overseas, including numerous semiconductor manufacturing and electronics systems companies, consulting firms, VLSI design companies, telecommunications, aerospace and defence sectors.

Lecturers and project supervisors in the programme are drawn from the School of Electrical, Electronic and Computer Engineering.

Enquiries for enrolment may be directed to Mr Rob Mattaboni, School of Electrical, Electronic and Computer Engineering, The University of Western Australia (enquiries@ee.uwa.edu.au
or +61 8 6488 3106).

ELEC8320 - Advanced Digital VLSI Design

Credit: 6 points

Availability: Semester 1

Outcomes: Students are able to design, analyse and test high performance digital VLSI systems.

Content: Students learn advanced Digital VLSI design techniques for the synthesis of high performance complex digital VLSI systems. The topics covered include transistor modeling, optimization for speed, low power design, High-speed logic, design automation tools, floor planning, clocking and interconnect issues, complexity management, memories and arithmetic blocks, and submicron design. Students make extensive use of CAD tools through a number of design projects.

Assessment: This consists of an examination and laboratory/project reports. The examination assesses students' understanding of concepts covered in the subject. The laboratory reports assess students' understanding of the area.

Prerequisites: ELEC4302 Digital Microelectronics System Design or equivalent, ELEC2301 Digital System Design or equivalent

Contact hours: 60 (lectures: 24 hrs; tutorials:12 hrs; labs: 24 hrs)

Unit Web Page: http://student.ee.uwa.edu.au/units/elec8320

ELEC8323 - Analogue Integrated Circuit Design

Credit: 6 points

Availability: Semester 2

Outcomes: Students are able to perform design and analysis of various analog integrated circuits.

Content: This unit provides students with a thorough understanding of the design and analysis of analog integrated circuits—single and multi-stage amplifiers, current mirrors, band gap voltage references, output stages and other analog building blocks. Students gain practical design experience with industry standard computer-aided design tools. Students leave with a fresh understanding of best analog design practices to address the requirements of lower power, lower noise or higher speed. Each student completes the analysis and design of an analog building block using a state-of-the-art deep sub-0.18 micron CMOS process. This real-world project highlights current issues that analog IC designers must face, such as mismatch and voltage supply reduction.

Assessment: This consists of an examination and laboratory/project reports. The examination assesses students' understanding of concepts covered in the subject. The laboratory reports assess students' understanding of the area.

Prerequisites: ELEC2301 Digital System Design or equivalent, ELEC3300 Analogue Electronics or equivalent

Contact hours: 60 (lectures: 24 hrs; tutorials: 12 hrs; labs: 24 hrs)

Unit Web Page: http://student.ee.uwa.edu.au/units/elec8323

ELEC8324 - Compound Semiconductor Devices

Credit: 6 points

Availability: Semester 1

Outcomes: Students are able to understand the role of compound semiconductors in modern high performance electronics; understand new structures which take advantage of hetero-structures; and gain an understanding of which semiconductor families are applicable for various applications; design hetero-structure devices for particular applications; and model hetero-structure based devices.

Content: This unit covers transistor types, their characteristics and design, common compound semiconductors, HBTs, HEMTs, advanced heterostructure devices, and performance calculations.

Assessment: This consists of an examination and laboratory/assignment reports. The examination assesses students' understanding of concepts covered in the subject. The laboratory reports assess students' understanding of the area.

Prerequisites: ELEC2304 Physical Electronics 2 or equivalent

Contact hours: 48 (lectures: 24 hrs; tutorials/labs:24 hrs)

Unit Web Page: http://student.ee.uwa.edu.au/units/elec8324

ELEC8325 - Design for Testability

Credit: 6 points

Availability: Contact the School of Electrical, Electronic and Computer Engineering

Outcomes: Students gain an understanding of concepts for IC testing and techniques for designing testable ICs.

Content: This unit introduces students to the main aspects of mixed-signal (digital/analog) circuits testing. Emphasis is on design for test (DFT) methodologies, which currently play an essential role in the design and production of integrated circuits. Topics include failures and fault models, Idqq testing, defect diagnosis techniques, internal scan techniques, ATPG for scan circuits, principle of pattern generation, fault simulation—techniques and use, built-in self test (BIST) and boundary-scan techniques. At the end of the unit, students are able to define the test protocol for a design and customise the initialisation sequence, if needed.

Assessment: This comprises an examination and laboratory/assignment reports. The examination assesses students' understanding of concepts covered in the subject. The laboratory reports assess students' understanding of the area.

Prerequisites: ELEC2301 Digital System Design or equivalent

Contact hours: 48 (lectures: 24 hrs; tutorials/labs: 24 hrs)

Unit Web Page: http://student.ee.uwa.edu.au/units/elec8325

ELEC8326 - Micro-electromechanical Systems

Credit: 6 points

Availability: Semester 2

Outcomes: Students gain an understanding of what MEMS devices are, what functions they perform and what applications they may be used for. They understand the fabrication process and the limitations and requirements for fabricating MEMS. They gain knowledge on how micro actuators and micro sensors operate and design requirements for the devices.

Content: This unit discusses the state-of-the-art in Micro-Electro-Mechanical System (MEMS). The unit contains the following topics: introduction to lithography; understanding the role of photoresists and polyimides in MEMS; the role of surface tension and gravity; assembly of out-of-plane 3–D MEMS structures; microlens design, fabrication and analysis; actuation methods including voltage and charge drive, comb and scratch drives, thermal actuation and piezoelectric actuation; microfluidics and associated pumping mechanisms; understanding of micromachining methods namely bulk micromachining, surface micromachining and LIGA; deposition, etch and release processes; thin film issues—stress and strain; MEMS applications which are used as case studies include air bag sensors, pressure sensors and inkjet printers.

Assessment: This consists of an examination and laboratory/assignment reports. The examination assesses students' understanding of concepts covered in the subject. The laboratory reports assess students' understanding of the area.

Advisable prior study: an undergraduate degree in Electrical, Mechanical or Materials Engineering or Physics

Contact hours: 48 (lectures: 24 hrs; tutorials/labs: 24 hrs)

Unit Web Page: http://student.ee.uwa.edu.au/units/elec8326

ELEC8327 - Opto-electronic Devices

Credit: 6 points

Availability: Contact the School of Electrical, Electronic and Computer Engineering

Outcomes: Students are able to understand the material requirements for use as opto-electronic devices, understand the concepts for design of devices, analyse opto-electronic device operation, be familiar with various types of opto-electronic devices and the operation of the devices.

Content: This unit includes topics on semiconductor materials for opto-electronics, description of various opto-electronic devices, design of opto-electronic devices, characterisation and operation of devices, reliability and failure.

Assessment: This consists of an examination and laboratory/assignment reports. The examination assesses students' understanding of concepts covered in the subject. The laboratory reports assess students' understanding of the area.

Prerequisites: ELEC3304 Physical Electronics 3 or equivalent

Contact hours: 48 (lectures: 24 hrs; tutorials/labs: 24 hrs)

Unit Web Page: http://student.ee.uwa.edu.au/units/elec8327

ELEC8328 - System-on-a-Chip Design

Credit: 6 points

Availability: Contact the School of Electrical, Electronic and Computer Engineering (See Timetable) Old unit code: ENGT8328

Outcomes: Students are able to design and test System-On-a-Chip (SOC) circuits.

Content: This unit focuses on the integrated circuit (IC) industry paradigm shift from stand-alone chips and ICs to integrated Systems-On-a-Chip (SOCs). Students gain a solid knowledge of the SOC design process including system level design, structural chip design and physical chip design. Emphasis is on intellectual property (IP) centred design methodologies. Students learn how to design, connect and implement these large IP blocks to address the requirements of speed, bandwidth, noise and power consumption.

Assessment: This consists of an examination and laboratory/project reports. The examination assesses students' understanding of concepts covered in the subject. The laboratory reports assess students' understanding of the area.

Prerequisites: ELEC8320 Advanced Digital VLSI Design or equivalent

Contact hours: 60 (lectures: 24 hrs; tutorials: 12 hrs; labs: 24 hrs)

Unit Web Page: http://student.ee.uwa.edu.au/units/elec8328

ELEC8329 - VLSI Technology and Reliability

Credit: 6 points

Availability: Contact the School of Electrical, Electronic and Computer Engineering

Outcomes: Students gain an understanding of process flows for device fabrication, issues related to growth of silicon and silicon oxide, the calculation of implantation depths and profiles, other issues associated with implantation, the latest issues with contacts and interconnects, the latest issues with lithography, the different isolation technologies and the advantages/disadvantages of each, the current foreseen limitations of the present fabrication processes and the possible solutions.

Students can design packages that provide good heat dissipation, good electrical performance and high reliability and which are able to be assembled and tested. They know and are aware of the design rules for packaging VLSI devices, can compensate for decreasing device feature size when designing packages, understand the mechanisms which lead to unreliable devices and model the mechanisms, calculate acceptable levels of device failures, perform accelerated ageing tests, understand and minimise hot carrier degradation and are aware of and can reduce problems with thin gate oxides.

Content: This unit covers device fabrication, lithography, current and future issues in device fabrication, packaging, testing, design rules, reliability and failure mechanisms and calculations, accelerated ageing tests, hot carrier degradation and thin oxide effects.

Assessment: This comprises an examination and laboratory/assignment reports. The examination assesses students' understanding of concepts covered in the subject. The laboratory reports assess students' understanding of the area.

Advisable prior study: ELEC4302 Digital Microelectronics System Design or equivalent

Contact hours: 48 (lectures: 24 hrs; tutorials/labs: 24 hrs)

Unit Web Page: http://student.ee.uwa.edu.au/units/elec8329

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