MASTER OF ENGINEERING BY TAUGHT COURSE

Degrees granted:
M. Eng. (Computer and Microelectronic Systems) - [Program code MKEH]
M. Eng. (Mechatronics and Automatic Control) - [Program code MKEM]
M. Eng. (Electronics and Telecommunication) - [Program code MKEL]
M. Eng. (Electrical Power) - [Program code MKEP]

School of Electrical Engineering (SEE) offer Master program by taught course that provide students to study in one of our four specialized Masters programs. At SEE, we offer a range of specialized courses founded on a unified philosophy of engineering teaching, which ensures the breadth of technical knowledge demanded of a professional engineer. Our curricular are in-line with industry needs.

Mode of Study:
Graduate students can pursue an on-campus or off-campus taught course program. On-campus taught course programs are offered at UTM's main campus in Johor Bahru. Select off-campus programs are available at the UTM Kuala Lumpur campus or other centres.

- **On-campus (PERDANA):** The on-campus study requires a minimum duration of 1.5 years (three semesters). The student may register a maximum of twenty (20) credits in the normal semester and maximum of ten (10) credits in short semester. The class sessions take place during weekdays. International students on study visa can only register for this mode of study.
- **Off-campus (PESISIR):** Off-campus study normally takes 2 years (4 normal semesters and one 8-week short semester) to complete. The student may register a maximum of twelve (12) credits in the normal semester and maximum of six (6) credits in short semester. Classes are scheduled on weekends to suit working professionals. Expatriates on working visa and permanent residents may register in this mode of study.

Teaching Methods: A taught module takes the following forms: formal lectures, tutorials, assignment and/or laboratory work as well as industrial exposure. Each 3-credit module is delivered in 42 hours of lectures. Teaching/learning is student-centered; hence it should be complemented with adequate self-study and self-learning by the students.

Assessment and Grading: Students' progress is assessed (continuously) throughout the semester by a coursework assessment component and a final examination for each module. The coursework component may consist of set written assignments, practical work/lab assignments, and short tests. Passing mark for each taught module is 60% or equivalent to B-. Any failed core course must be repeated with that same course, while failed elective course can be replaced with another elective course approved by the Postgraduate office.

Students must obtain at least 2.67 *cumulative grade point average* (CGPA) or equivalently a B- average for each semester to continue the study. For a Masters degree to be awarded, candidates must complete a minimum of 43 credits and achieve a final CGPA≥ 3.00. Table IV in the appendix shows the academic standing and students' status.

Students may also register a course under *HS* (attendance only). In order for this module to appear in the transcript, students' attendance must be at least 80% and fulfill other coursework requirements.

Master Project: Students must undertake a 10-credit master's project. This 1 year (2-semester) project will be supervised by a graduate faculty member of FKE. Towards the end of the 1st semester, students will defend their project proposal. At the end of the project in the second semester, students must defend their Masters project and a comprehensive project report must be submitted. The Masters project could be industry-related although must still meet academic requirements, defined by the academic supervisor. An industry co-supervisor may be appointed from persons with appropriate academic standing or experience, subject to approval of the Faculty's Academic Committee.

OFF-CAMPUS (PESISIR) MODE OF STUDY

Our off-campus programs offer flexible solutions for working engineers and professionals to advance their career through our industry-driven curricula. All of our Masters programs are accredited by the Malaysian Qualification Agency (MQA).

Classes taught by Universiti Teknologi Malaysia faculty members at our PESISIR centres. The fees are affordable and competitive. Our PESISIR program can be completed within 2 years (four normal semesters and one short semester). Classes are conducted on Saturday and Sunday at all study centres.

- **Johor Bahru** **:** Universiti Teknologi Malaysia Main Campus
- **Kuala Lumpur** **:** Universiti Teknologi Malaysia City Campus
- **Pulau Pinang** **:** Penang Skills Development Centre
- **Kuching** **:** Technology College Sarawak

Programs	**Study Centers**			
	Johor Bahru	**Kuala Lumpur**	**Pulau Pinang**	**Kuching**
MKEH	–	–	MKEHA1BPA	–
MKEL	MKELA1BJA	MKELA1BKA	–	–
MKEM	–	MKEMA1BKA	–	–
MKEP	MKEPA1BJA	MKEPA1BKA	–	MKEPA1BQA

* Other programs may be offered in other centres depending on demands.

General Information

1. Awarding Institution			Universiti Teknologi Malaysia	
2. Teaching Institution			Universiti Teknologi Malaysia	
3. Programme Name			Master in Electrical Engineering	
4. Final Award			Master of Engineering (Computer and Microelectronic Systems) Master of Engineering (Mechatronics and Automatic Control) Master of Engineering (Electronics and Telecommunication) Master of Engineering (Electrical Power)	
5. Programme Code			MKEH/MKEM/MKEL/MKEP	
6. Professional or Statutory Body of Accreditation			Kementerian Pendidikan Malaysia	
7. Language(s) of Instruction			English and Bahasa Melayu	
8. Mode of Study (Conventional, distance learning, etc)			Conventional	
9. Mode of operation (Franchise, self-govern, etc)			Self-governing	
10. Study Scheme (On-campus/Off-campus)			On-Campus/Off-Campus	
11. Study Duration			Minimum : 1.5 yrs Maximum : 4 yrs	
Type of Semester	No. of Semesters		No of Weeks/Semester	
	Full Time	Part Time	Full Time	Part Time
Normal	3	4	14	14
Short	0	1	8	8

Course Classification

No.	Classification	Credit Hours	Percentage
i.	University Courses a. Non- technical subject b. Introduction to Research Methodology in Electrical Engineering	 3 3	14%
ii.	Faculty/Programme Core	12	27.9%

iii.	Programme Electives	12	27.9%
iv.	Master Project	10	23.2%
v.	Free Elective Course	3	7
	Total Credit Hours	**43**	**100%**
Total Credit Hours to Graduate		**43 credit hours**	

MASTER OF ENGINEERING (COMPUTER & MICROELECTRONIC SYSTEM)

PROGRAMME SPECIFICATIONS

The program is an advanced degree program that exposes and updates students to cutting-edge technologies and techniques in computer engineering, IC microchip design, microelectronics system and advanced electronics in new generation technologies. With the ever increasing demand in digital devices, semiconductor based companies are facing the challenges of producing higher performance, cost effective, but smaller microchips. This program covers both the theoretical and practical aspects of computer engineering and microelectronics system. It is designed especially for engineers to complement their industrial expertise and enhance their knowledge skills. This program was formed from our close collaboration with our industry partners (such as INTEL). The curriculum and some of the courses were developed based on the technical needs for upskilling and advancing the knowledge of their engineers.

Our programme is offered in full-time and part-time basis. Full-time classes are conducted at our Johor Bahru main campus. Part-time classes are currently conducted in INTEL, Penang. The fees are affordable and competitive. Our off-campus program can be completed within 2 years (four normal semesters and one short semester). Classes are conducted on Saturday and Sunday at the study centre.

Programme Educational Objectives (PEO)

PEO1 Mastery of knowledge and competency in advanced areas of Computer Engineering and Microelectronic field.

PEO2 Professionalism and high standards of ethical conducts within organization and society.

PEO3 Responsive to changing situations by continuously acquiring new knowledge and skills.

Programme Learning Outcomes (PLO)

PLO1 Attain advanced knowledge on theories, methods and applications related to Computer Engineering and Microelectronic field.

PLO2 Demonstrate mastery in conducting research independently in solving problems related to Computer Engineering and Microelectronic through relevant analytical methods, simulations and/or experiments.

PLO3 Synthesize engineering knowledge through design and development.

PLO4 Plan and perform research undertakings responsibly, professionally and ethically.

PLO5 Communicate and express knowledge and ideas effectively.

PLO6 Continue life-long learning and apply technology for the betterment of humanity.

GRADUATION CHECKLIST

To graduate, students must pass all the stated courses in this checklist. It is the responsibility of the students to ensure that all courses are taken and passed. Students who do not complete any of the course are not allowed to graduate.

NO.	CODE	COURSE	CREDIT EARNED (JKD)	CREDIT COUNTED (JKK)	TICK (√) IF PASSED
MASTER OF ENGINEERING (COMPUTER & MICROELECTRONIC SYSTEM)					
FACULTY COMPULSORY-12 CREDITS (4 COURSES)					
1	MKEL 1113	Nanoelectronic Devices	3	3	
2	MKEL 1123	Advanced Microprocessor Design	3	3	
3	MKEL 1173	Advanced Digital System Design	3	3	
4	MKEL 1193	Analogue CMOS Design	3	3	
FACULTY ELECTIVES-12 CREDITS (4 COURSES)					
5	MKEL 1133	Integrated Circuit Testing	3	3	
6	MKEL 1143	Advanced Digital Signal Processing	3	3	
7	MKEL 1163	VLSI Circuits & Design	3	3	
8	MKEL 1183	Advanced Computer Architecture	3	3	
9	MKEL 1223	Random Process	3	3	
10	MKEL 1233	Image Processing	3	3	

11	MKEL 1243	Software Engineering	3	3	
12	MKEL 1253	Speech Processing	3	3	
13	MKEL 1263	Special Topic in Electronic Engineering	3	3	
14	MKEL 1273	VLSI Design Automation	3	3	
15	MKEL 1283	Hardware and Software Co-Design	3	3	
FREE ELECTIVES FROM MKEL/MKEM/MKEP/MKET-3 CREDITS (1 COURSE)					
16	MKEx 1xxx		3	3	
MASTER'S PROJECT-10 CREDITS (2 COURSES)					
17	MKEH 1814	Research Project Proposal	4	4	
18	MKEH 1826	Research Project Report	6	6	
TOTAL CREDIT OF ELECTRICAL ENGINEERING COURSES (a)			**37**	**37**	
SCHOOL/UNIVERSITY COMPULSORY- 6 CREDITS (2 COURSES)					
19	MKEU 0013	Introduction to Research Methodology in Electrical Engineering	3	3	
20	Uxxx xxx3	Non-technical subject	3	3	
TOTAL CREDIT OF UNIVERSITY COMPULSORY COURSES (b)			6	6	
TOTAL CREDIT TO GRADUATE (a + b)			**43**	**43**	

COURSE SYNOPSIS

CORE COURSES

MKEL 1113 - Nano-electronic Devices

Semiconductors form the basis of most modern electronics systems. This course is designed to provide a basis for understanding the characteristics, operation, and limitations of semiconductor devices. In order to gain this understanding, it is essential to have a thorough knowledge of the physics of the semiconductor material. The goal is to bring together quantum mechanics, the quantum theory of solids, semiconductor material physics, and semiconductor device physics. All of these components are vital to the understanding of both the operation of present day devices and any future development in the field. This course is a continuation to Microelectronics at the undergraduate level and introduces advanced device concepts.

MKEL 1123 - Advanced Microprocessor System

This course is about microprocessors in embedded systems. This course extends the students' knowledge of microprocessors by investigating embedded

systems design and state-of-the-art 32-bit embedded processors. The student will be familiarized with problems associated with producing hardware and software in high-level language and assembly language for embedded systems. The topics covered include high-level and assembly language programming for embedded microprocessors, memory and peripherals for embedded systems, system development, and achieving high-performance in embedded systems.

MKEL 1173 - Advanced Digital System Design
This course is designed for students to learn and be able to design and verify complex digital synchronous systems – towards becoming an RTL digital hardware designer in the industry. This is a course that goes beyond the introductory course on digital basic principles and techniques. This course introduces digital circuit modelling with hardware description languages (HDLs), which is the key technique to the modern design of integrated circuits (ICs). The technique involves a CAD approach in which a high-level, text-based, abstract description of the circuit is created, then synthesized to a hardware implementation on a selected technology, and finally verified for its functionality and timing.

MKEL 1193 - Analog CMOS Design
In this course, students will be taught the characteristics of MOSFET transistor as a prerequisite of CMOS analog design. It highlights the nonlinearity as an imperfection that will limit the performance of analog circuits. The course will then proceed to analyse CMOS single ended as well as differential amplifiers. The advantages and disadvantages between different architectures will be discussed which designers could choose to fit their design requirements. The trademark of analog design, which is the design challenge to fulfil design matrix, will be highlighted. Students will be guided on design principles to meet design specifications with acceptable accuracy. Other important sub-modules such as differential amplifier, op amps, and switch capacitor amplifiers will be addressed towards the end of the course.

ELECTIVE COURSES

MKEL 1133 - Integrated Circuit Testing
This course introduces students to the techniques of testing a circuit and designing a testable circuit. Several fault models including single stuck-at fault model will be analyzed in details. Fault simulation methods are covered as well in this course. Test pattern generation and design-for-testability are also introduced to students. In order to facilitate the learning process, computer-aided design (CAD) software is used throughout the course. Some practical or almost actual environment problems and solutions are provided.

MKEL 1143 - Advanced Digital Signal Processing
This course introduces students to advanced concepts in digital signal processing. Basic concepts in signal processing will be first reviewed that covers continuous and discrete-time signals and systems with the relevant transformations and operations. Random signal principles are presented with the definition of stationarity and ergodicity, correlation and covariance functions and their estimates. The power spectrum of signals is defined together with the relationship with to the correlation function. Linear systems with random inputs are defined in terms of autocorrelation and cross correlation function and power spectrum. Optimum filtering techniques such as matched filter and wiener filter are presented with examples of applications. Basic constraints in non-parametric power spectrum estimation are described with the appropriate solutions. Linear estimation techniques deal with parameter identification and estimation of signals. Linear prediction is used for signal modelling and prediction. Towards the end of the course, signal analysis and representation techniques for time varying signals are presented such as the short-time Fourier transform, Gabor transform, and wavelet transform.

MKEL 1163 - VLSI Circuits & Design
In this course, students learn about VLSI design, with emphasis on designing circuits to meet certain performance criteria. Important issues when designing a VLSI circuit are discussed. MOS transistors are reviewed, including their characteristics, structure, switch-level behaviour, and current equation. SPICE model of MOS transistors is also described. The inverter circuit is studied in detail. This course emphasizes circuit design for speed and power performances. Factors that affect speed are explained. Logical effort concept is introduced to explain how to design a fast circuit. Similarly, the effect of input signal transitions on power dissipation is explained

MKEL 1183 - Advanced Computer Architecture
This course covers hardware structure of a modern programmable computer, including the basic laws underlying performance evaluation. Students will learn design of control and data path hardware for RISC processor, how to make machine instructions execute simultaneously through pipelining and parallel execution, and how to design fast memory and storage systems.

MKEL 1223 - Random Process
This course introduces students to the concepts in random processing. This course introduces students to the introductory level of random variables and random process. In the beginning, students will be introduced to the concept of probability and its axioms, Bayes theorem, combinations, and permutations. Then the concept of random variable which includes probability density and cumulative functions will be given. This topic will be extended to operations on random variable such as expectation and moments. The topic of multiple random variables which consists of joint distribution and joint density along with conditional distribution and density will be discussed next. This topic will also

include operations on multiple random variables. Finally, the topic on random process from the perspective of both the temporal and spectral domains will be given. This topic will cover wide sense stationary, ergodicity and independence, correlation functions, power density spectrum and cross-power density spectrum.

MKEL 1233 - Image Processing

This course introduces students to introductory and intermediate levels of image processing techniques. The area of coverage would be the digitization process as a mean to acquire the digital image. Next would be the enhancement and restoration processes which are to improve the quality of the image for next stage processing. Both the spatial domain and frequency domain approaches will be covered. The next stage would be the segmentation process. This is an important step towards advanced level processing. Another important topic that will also be discussed is the morphological processing. Wavelet transform and multi-resolution analysis have been pivotal in many image processing applications and thus the introduction to this area will be given. Finally, the topic of compression and coding will be covered. MATLAB will be used extensively for better understanding.

MKEL 1243 - Software Engineering

This course introduces various issues of system and software engineering. This course attempts to cover a vast field covering all aspects of system and software development work from analysis, design, implementation, operation, maintenance, support, cost, management, and risk analysis. Focuses will be given on software development process, programming, testing, and maintenance, which are the fundamental aspect of software engineering. Special emphasis will be given to the process of object oriented design as well as the use of UML in the design activities.

MKEL 1253 - Speech Processing

This course introduces students to introductory and intermediate levels of speech processing techniques. The area of coverage would be speech production mechanism, classification of speech, sounds, nature of speech signal, models of speech production, speech signal processing: the purpose of speech processing, digital models of speech signal, digital processing of speech signals, Significance, short time analysis. Next would be the time domain parameters of speech, methods for extracting the parameters, zero crossings, auto correlation function, pitch estimation. The next stage would be the short time Fourier analysis, filter bank analysis, spectrographic analysis, format extraction, pitch extraction, analysis – synthesis systems. Another important topic that will also be discussed is the formulation of linear prediction problem in time domain, solution of normal equations, interpretation of linear prediction in auto correlation and spectral domains. MATLAB will be used extensively for better understanding

MKEL 1263 - Special Topic in Electronic Engineering

The aim of the Special Topic course is to provide a mechanism for one-off topic to be offered by any graduate faculty or visiting professor. The topic of any Special Topic course has to be vetted and endorsed by the Faculty's Academic Committee.

MKEL 1273 - VLSI Design Automation

In this course, students learn about computing methodologies and algorithms for VLSI design automation. The course covers fundamental techniques in VLSI physical design automation flow; from system partitioning and chip floorplanning; placement and routing with global, detailed and specialized techniques, to timing closure. Students will also explore, study, and implement some of the advanced techniques used in EDA tools.

MKEL 1283 - Hardware and Software Co-Design

The course covers the design and development aspects of heterogeneous (hardware/software) digital systems. This course explores the process involved in defining system specification and how design space exploration can be done. Special focus is given on design quality and cost estimation, partitioning source description into different implementation domains, target code generation, interface synthesis and co-verification.