UNIVERSITY OF WOLLONGONG IN DUBAI

Bachelor of Engineering (Honours) - Computer and Autonomous Systems Engineering

The Bachelor of Engineering (Honours) degree is a four year degree with a common first year where you will learn more about engineering and its different fields before deciding which discipline to study. The common first year provides you with sound fundamentals in mathematics, statistics, physics, chemistry, computing, engineering science and communication, mechanics, materials and fluids. You then focus on your chosen major study from second year.

To qualify for award of the degree of Bachelor of Engineering in any of this major, a candidate shall accrue an aggregate of at least 192 Credit Points (cp), which includes one general elective chosen from the general education subjects, in addition to two more general education subjects, for a total of 204 (cp). In addition, the student completes the professional experience subject ECTE399. Students are also required to accrue an overall weighted average mark (WAM) of 50%. The degree consists of core subjects, major subjects, thesis, electives and general education subjects details of which are below:

Year 1

Engineering Computing and Analysis

This subject teaches algorithm design and computer programming using MATLAB. Students will develop a systematic approach to analyse engineering problems and create algorithms that solve real-world problems. Topics will include: problems solving techniques; algorithm design; data types and operators; conditional and repetitive control flow; file access; functions; data visualisation; code optimisation; arrays/matrices; and vectorisation. Students will also focus on computational tools to solve engineering problems such as kinematics of rectilinear and curvilinear motion.

Fundamentals of Engineering Mechanics

In this subject student will explore fundamental laws of motion and their application to the analysis and design of simple structures. Students will undertake a series of design and build projects to see the effects of concepts of mechanics in real structures. Working in design teams, students will also explore the professional responsibilities of engineers in terms of accountability, liability and sound design and analysis techniques.

Materials in Design

In this subject student will explore the interrelationships between materials structure, properties, processing, application and lifecycle. Students will apply materials science and lifecycle analysis to develop solutions to engineering problem that are optimised for

sustainability. Students must consider both economic and environmental impact in the identification and selection of appropriate materials in engineering design.

Electrical Systems

ENGG104 introduces real-world electrical systems. The subject teaches fundamental electrical concepts: change, current, voltage, resistance, capacitance, inductance, energy and power. The subject introduces theorems to simplify AC and DC circuits through analysis and simulation. The subject also links the fundamental concepts to practical engineering applications such as motors and generators. The laboratory component covers measurements using electrical components and equipment, designing basic circuits, as well as report writing.

Engineering Design for Sustainability

In this subject, students will draw together engineering principles covered in other subjects to develop context-appropriate solutions to engineering challenges. Students will work in teams undertaking investigation, concept development, and detailed design that demonstrates innovative and creative thinking. Students must consider the technical, social, economic and environmental aspects of a design problem to produce solutions that are likely to be workable in the real world.

Foundations of Engineering Mathematics

The subject consists of two strands, Calculus and Linear Algebra. The Calculus strand covers differential calculus and introduces integral calculus. The Linear Algebra strand covers matrices, determinants and applications of these in the sub-topic of vector geometry. All of these are presented with accompanying examples from various engineering disciplines.

Essentials of Engineering Mathematics

The subject consists of two strands, Integral Calculus with applications and Series. The Integral Calculus strand presents a number of analytical and numerical integration techniques plus applications of integration to find areas, volumes of revolution and solve differential equations. The Series strand covers techniques for finding limits, determining the convergence of series and leads into Taylor series. All of these are presented with accompanying examples from various Engineering disciplines.

Physics for Engineers

Vectors and their applications; an introduction to the physical laws of electricity and magnetism, leading to an explanation of the generation of electromagnetic waves and some basic ideas in communication theory. Electric charge and Coulomb's law, electric fields, potential differences, capacitance, dielectrics and relative permittivity, electric current, resistance, Ohm's law, superconductivity, DC circuits and Kirchhoffs laws, magnetic fields and forces, electromagnetic waves and the EM spectrum, carrier waves, modulation and

bandwidth. Waves; reflection and refraction; interference; diffraction; polarization; optical instruments; quantum physics; waves and particles; atomic physics; the Bohr atom.

Year 2

Circuits and Systems

Topics covered in this subject include: dependent sources; circuit analysis techniques; generalised and complex impedance; energy storage elements L, C; natural, forced and complete response of first and second order circuits; phasors; frequency response; Bode plots; Laplace Transform and Fourier series; and magnetically coupled circuits.

Digital Hardware

Topics covered in this subject include: combinational logic, simplification of logic expressions, Karnaugh maps; sequential logic, flip-flops, registers, clock, timing and synchronisation problems; sequential machines, Mealy and Moore machines, timing diagrams and state tables; and programmable logic array and programmable logic controllers.

Engineering Electromagnetics

This subject aims to develop an understanding of the fundamental principles and physical laws of electromagnetism that are necessary for the design, analysis and implementation of better Electrical, Electronic and Communication systems in the 21st century. It provides in depth coverage of practical aspects of EM theory, with a focus on field and wave generation and propagation. The topics covered include vectors and fields, Maxwells equations, plane waves, transmission lines, waveguides, resonators, antennas, Rayleigh scattering and computational aspects of EM fields.

Digital Signal Processing

The aim of this subject is to provide students with a thorough understanding of the fundamental theory and applications of signals, systems, and digital signal processing. Topics covered include: mathematical representations of continuous-time and discrete-time signals; signal sampling and quantisation; linear-time invariant systems and convolution; the z transform and its applications; the Discrete Fourier Transform (DFT) and its applications, Fast Fourier Transform (FFT) algorithms; analysis, design, and implementation of digital filters; introduction to random signals, correlation, and matched filtering; spectrum analysis and estimation using windows. The laboratory component will enable a MATLAB-based practical investigation of the theoretical concepts introduced in lectures.

Electronics

This subject aims to provide students with an opportunity to develop an understanding of electronic circuit design using operational amplifiers as the building blocks and with an ability to analyse circuits using conventional methods. Topics covered include: the use of operational amplifiers in circuits eg. inverting and non-inverting amplifiers, small signal (unity bandwidth and gain-bandwidth product) and large signal (slew rate) frequency response of non-ideal operational amplifiers in inverting and non-inverting configurations; adders, filters/oscillators, instrumentation amplifiers, comparators, rectifiers, clippers, Analog to Digital and Digital to Analog circuits; the terminal characteristics of devices and their use in linear (amplifiers) and non-linear circuits eg. biasing and ac models (low and high frequency, characterising amplifiers, the Miller Effect and Miller Multiplier for the case of transistor circuits) for operational amplifiers and discrete circuit transistors, diodes/Zener diodes, transistors (MOSFETs, BJTs - including large signal Ebers-Moll Model); integrated transistor circuits for MOSFETs using active loads; combining devices into amplifiers eg. differential pairs, cascode and Darlington connections, Szlikai pairs, current sources and mirrors, push-pull; high frequency amplification and appropriate equivalent circuit models.

Engineering Design and Management 2

This subject consists of a structured team design activity covering the first four phases of a product design cycle. Student teams will undertake the entire project using staff as 'costed' advisors. The team activity will be supplemented by lectures covering such areas as: language and communications; teamwork; and an introduction to key project management design and development activities, including management concepts and tools, to enable engineers to effectively manage the design and development aspects of both a project and its associated activities.

Programming for Engineers

The primary topics areas in this subject include: introduction to the C Programming environment, use of pointers, dynamic memory management, arrays and structures, file input and output, multi-file programs and make files, testing and verification of software, implementation and properties of algorithms, concepts of object-oriented programming in C++ including classes and function overloading.

Year 3

Microcontroller Architecture and Applications

Topics covered in this subject include: computer organisation; central processing unit; memory; input and output devices; instruction sets; machine languages and assembly languages; microcontroller architecture; C programming for microcontrollers; digital input and output; serial communication; interrupt-driven processing; timers; pulse width modulators; analogue-to-digital and digital-to-analogue converters; and electronic sensors.

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Power Engineering 1

The topics covered in this subject include: basic structure of a power system; electric power generation; single and three phase systems; power system equipment: typical power system loads; transformers, switch gear and protection; installation practice: voltage drops, power factor correction, safety, earthing, protection equipment rating; power quality: system disturbances, equipment susceptibility, improvement and instrumentation; generalised overview of machines; fundamentals of power electronics.

Communication Systems

This subject aims to provide students with an understanding of the basics of modern communications systems. Topics covered include: base-band signalling, including transmission through band-limited channels; and band-pass signalling, incorporating digital modulation techniques.

Data Communications

Topics covered in this subject include: basics of data communications and fundamentals of computer networks; layered protocols; error correction techniques; network types and topologies; local area networks; wide area networks; packet switching; internet and transport protocols; and internet applications.

Control Theory

Topics covered in this subject include: mathematical modelling of physical systems; signal flow and state space representation of systems; steady state and transient analysis; root locus; frequency response analysis using Nyquist and Bode; design of PID, lag, lead, controllers using Bode and root locus methods; and multiloop control.

Engineering Design and Management 3

The aim of this subject is to provide students (in teams) with the opportunity to undertake a significant product development exercise, from target specification through to product launch. The emphasis is on the technical achievements of the team project. Student teams will undertake the entire project using staff as 'costed' advisors. The team activity will be supplemented by lectures covering such areas as an introduction to key implementation activities including: management concepts and tools to enable engineers to effectively manage the critical implementation aspects of projects; social and ethical considerations; psychology/ergonomics; and engineering test methodology.

Real-time Embedded Systems

This subject enables students to analyze, design and implement real-time embedded systems. The subject will consider topics including multi-tasking, real-time networking and communications, real-time operating systems, timing analysis, pre-emptive and non-pre-

emptive scheduling, and real-time programming languages. In particular, material will address embedded devices such as mobile phones and other internet-aware devices. The subject initially familiarizes students with the fundamentals of programming for real-time embedded systems. A laboratory will provide students with guided experiments that investigate the opportunities and challenges of programming on embedded devices and platforms

Professional Experience

This subject is a core subject in which students are required to complete, at least, 12 weeks of approved professional experience. This experience must be in an industry relevant to the degree that is being undertaken in order for students to gain exposure to the external industry environment and participate in a hands-on learning experience.

Year 4

Thesis A

In this subject students will be required to work on individual projects which may involve background reading and analysis; development of hardware, software or an experimental program; or simulation and analysis. It will involve weekly tutorial sessions, presentation of project outcomes and writing of technical reports. This subject provides students that have demonstrated a capacity to undertake high-quality, independent project work to further develop these skills.

Programming Autonomous Systems

Programming Autonomous Systems introduces students to the foundation of intelligent autonomous agents combined with a number of challenging hands-on applications. The subject will start with an introduction to the field of mobile robots. At its core the subject will address the problems of localisation, planning and control, perception, robot motion and navigation. Finally, drawing further upon a range of the intersecting fields of AI, Machine Learning, Cognitive Robotics and Knowledge based Intelligent Systems, plus an exploration of related frameworks, such as Behaviour Cloning, CHURPs and Deep Reinforcement Learning to facilitate incremental learning enhancements of control and behavioural skills in an autonomous system.

Choose 2 Major Subjects

Multimedia Signal Processing

The aim of this subject is to extend the digital signal processing knowledge gained in ECTE301 Digital Signal Processing to areas of prominent applications. The applications include speech and audio processing where human auditory process is modelled accurately for very high compression. The subject also explores concepts such as Quality of Speech, noise removal, quantisation, auditory

masking. Latest compression standards such as MP3, Advanced Audio Coding (AAC) and Dolby compression standards are also explored as part of Speech and Audio Processing. The second half of the subject is extended to concepts such as image noise, filtering techniques to enhance noise corrupted images, thresholding, grey-level mapping, image compression, motion estimation and compensation for video compression and morphological filtering.

Robotics and Flexible Automation

The subject provides the knowledge and skills required to design appropriate robotic systems for flexible automation, including the modelling, analysis, design, and deployment of a robotic manipulator and its associated sensory systems. The contents will consist of: Industrial robots, as a component of automation; mathematical modelling of a robotic arm; direct and inverse kinematics model; direct and inverse dynamic model; trajectory planning; control systems for industrial robots; tactile sensors; force sensors; ultrasound sensors; computer vision; and other sensors.

Embedded Systems

The subject will examine the key properties of software, firmware, and hardware systems in the embedded, resource constrained, mobile, and highly distributed world. It will explore topics, including embedded processors instruction sets, performance and power consumption, the embedded computing platform, program analysis and design, embedded processors and operating systems, hardware accelerators, networks for embedded systems, and systems-on-silicon.

Choose 2 Technical Electives

Queuing Theory and Optimization

This subject will provide the essential theoretical and practical foundations for the design and optimisation of large-scale distributed systems. There is a particular emphasis on the telecommunication network planning as an example, but students will also be exposed to other cases and the knowledge gained will have applications in many diverse domains. The first part will cover the fundamentals of queuing theory. The basic properties of stochastic processes are reviewed. Markov modelling, including discrete Markov processes and its application in describing random sequence of events is presented. Then the properties of exponential distribution, Poisson distribution, M/M/1 queues, queues with finite capacity, queues with general service distribution and open queuing networks are presented. Students will be exposed to properties of these systems by using both analysis and simulation. The second part will cover the basics of graph theory, followed by an introduction to linear optimisation, including Linear Programming, Simplex algorithm, Integer Linear Programing, and the Branch and Bound algorithm. The students will then be exposed to fundamentals of non-linear optimisation and Lagrange Method as well as methods to assess the complexity of a problem. Finally a number of important heuristics for solving large-scale optimisation problems will be presented. Students will experience the various optimisation techniques by using both analysis and simulation.

Power Distribution Systems

The aim of this subject is to provide students with an understanding of the design concepts and operation of electrical power distribution systems relevant to the electrical utility industry and industrial plants containing large power distribution applications. Topics covered in this subject include: an introduction to distribution system planning and automation; load modelling and calculations; system equipment modelling and selection; protection and insulation coordination; power quality and system load interaction; design of radial systems; voltage control; capacitor applications; earthing and reliability.

Power Electronics and Drives

The aim of this subject is to provide students with an understanding of power conversion circuits using modern power switching devices and their application to equipment supplies and the control of electric drives. Topics covered include: power switching devices and their application, dc-dc converters, ac-dc converters, including switch-mode power supplies, dc-ac conversion using inverters, methods of pulse width modulation, selection of motors for industrial applications, and the design of closed loop speed control systems for dc and ac motors.

Computer Architecture

The aim of this subject is to provide students with the knowledge of current computer architecture and the skill to design and interface an RISC processor. The topics covered include processor data path and control, CPU architecture, performance issues, enhancing performance through pipelining, memory hierarchy, Cache, DMA, Buses and other connections, interfacing I/O devices and I/O performance measurements.

Power System Analysis

The aim of this subject is to provide students with an understanding of the advanced techniques required for power systems calculations and analysis. Topics covered in this subject include: an introduction to power systems comprising thermal and hydro power stations; transmission lines and distribution systems; computer applications in power systems planning; design, control and operation; review of basic analysis tools; reactive power management; load flow and fault analysis; and transient stability.

Network Engineering

This subject primarily covers large scale IP networks. In addition to considering architectures and protocols, a key focus will be the development of analytical techniques to assist the design and performance monitoring of these networks. Topics will include: ISP architectures; BGP routing; mobile IP; IP QOS; MPLS; ATM; multimedia applications; peer to peer networking and network management.

Wireless Communication Systems

This subject will provide fundamentals and advanced knowledge of wireless communication systems. Students will also be exposed to practical equipment and network simulation tools. Topics covered include: electromagnetism fundamentals; antennas analyses and simulations; antenna impedance matching; Friis transmission equation and applications; multi-path propagation; path-loss models; link budget, large and small scale fading models; single carrier systems; spread spectrum technique and applications; code division multiple access and RAKE receiver; multi-carrier systems; orthogonal frequency division multiplexing; advanced channel equalisations in time and frequency domains; cellular concept and system design fundamentals; mobility management; multi-user communications in wireless systems, medium access control, wireless networks and protocols, and new multiple access techniques for 5G and future generation wireless communications. Case studies will also be undertaken.

Internet of Things

The next evolution of the Internet will encompass ‘things’ that are equipped with processing, sensing and communication abilities. This so called Internet of Things (IoTs) will help realise smart cities, smart agriculture, smart grid, and also revolutionise industries ranging from health, agriculture, and transport. This subject will take a cross-disciplinary approach that covers topics ranging from electronics, embedded systems, sensors, actuators, energy management, communication systems, and data processing and management. In addition, it will cover IoTs applications or use cases, industry standards, Machine-to-Machine (M2M) technologies, and wireless sensor networks. Lastly, the subject will provide students with opportunities to design an IoT application and also solve problems that may arise in an IoT system.

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*General Education Subjects**

*Can be taken in any year of your degree

Choose 1 UAE Studies Subject

Urban Sociology

The societies and places in which we live are very complex, and the interactions of individuals, as well as social institutions, have a direct impact on the life path we take. This course provides an engaging and accessible introduction to urban sociology and the study of cities, with particular focus on the experience of the UAE and Dubai. We’ll examine a number of substantive urban topics, including but not limited to the growth of cities and urban spaces in the UAE, sustainable development and practices, and the ‘built’ environment.

Public Health

This course will introduce Public Health as an interdisciplinary science concerned with topics central to the population of U.A.E and on a wider scale of GCC region with regard to their physical, mental, and social well- being. The course focuses on current pertinent public health problems, assessing

causation and examining intervention and management strategies at personal, social, and organizational levels.

UAE and International Relations

This course offers an overview of the UAE's rapidly emerging significance and its increased roles in global networks of international relations and diplomacy. Within that overview, the course examines the internal dynamics of the UAE, in particular, the priorities that emerge from a specific workforce dependency, a construction and tourism industry that looks 'East' as much as it does 'West'. Thus the new 'Look East' policy complements the country's historical partnership with the Western states. With the expansion of its global ties and relations, the UAE also becomes more sensitive to transnational issues, such as immigration, fluctuations in international markets or terrorism.

Society and Environment – Resources, Challenges, Futures

This subject aims to provide an understanding of relations and interactions between society and environment, including impact of societies on the Earth and its processes. Topics covered include the agricultural, industrial and urban revolutions; governance of environments; Indigenous land management; climate change; sustainability; and environmental impacts in the context of the Anthropocene.

Take 1 Arabic Language Subject or Challenge Test

Arabic Language

Language is key to everything we do. From verbal communication and the way we talk, to non-verbal communication and the emojis we use in our text messages, to the visuals we use to construct compelling visual stories, language is how we communicate. Living, studying and working the UAE, having a basic understanding of Arabic language can give you a huge competitive advantage. This introductory subject provides some of the basics of Arabic language, and you'll leave this subject able to communicate on a basic, conversational level.

Compulsory General Education Subject

Muslim Societies Across the Ages: Tradition, Secularism & Modernity

This course aims to provide students with critical thinking perspectives about the relationship between history, religion and culture, in this case, the formation of Islamic culture(s). A sociological introduction to the study of Islamic culture will introduce students to the emergence of Islam in its 7th century historical context, its relationship to the other monotheistic traditions of the region, its growth into the dominant cultural paradigm of the Near East by the 9th century, alongside its impact and contribution to key fields of medieval science and knowledge. A historical approach will help students acquire familiarity with key Islamic texts, institutions, concepts of authority, traditions of

jurisprudence and spirituality, artistic expressions, as well as milestones in Islamic history. The course wraps up with a discussion of issues central to contemporary debates relating to Islamic culture, such as identity, gender, multiculturalism, pluralism, secularism and religiosity.