Summary of UG Course Outcomes

Course	Course Outcomes
1000-Level Courses	
ELEC 1020	Upon completion of this course, students will be able to: CO1 - understand the basic principles of human perception of sound, image, video and graphics, and their applications to modern media technologies. CO2 - understand the basic principles of the capture, editing and playback technologies of sound, image, video and graphics, such as microphone, camera, DVD, mp3, radio, television, computer games, home entertainment system, gaming device, smartphone, youTube, speaker, etc. CO3 - develop appreciation of beauty, communication, and storytelling as related to sound effects, lighting effects, camera tricks, motion sequence, etc. CO4 - develop basic operational skills of media capture and editing software for sound (e.g. Adobe Audition), image (e.g. Adobe Photoshop), video (e.g. Adobe Premier) and graphics (e.g. Macromedia Flash). CO5 - apply media technology skill and knowledge to create video projects with themes related to society and mankind using English, Cantonese or Putonghua languages. CO6 - develop communication skills, team playing spirit and joint creativity skill.
ELEC 1100	Through hands-on labs and term project, complemented with lectures and tutorials, students will be able to: CO1 - *recognize* the history and development of major ECE fields. CO2 - *analyze*, *design*, and *debug* simple analog circuits, combinatorial and sequential logic circuits, and *design* and *implement* simple feedback control strategies. CO3 - *build* a real engineering system following a hierarchical design principle. CO4 - *work* in a team environment: learn and practice effective project and time management. CO5 - *execute* a complete project from problem formulation, design/implementation, up to verification and documentation.

ELEC 1200	CO1 - Through the study of a voice communication system, students will understand the practical context of the concepts that they study in more theoretical detail in other classes. CO2 - Students will be able to explain typical problems and tradeoffs encountered in electronic and computer engineering systems. CO3 - Students will be able to analyze simple approaches to deal with these problems and tradeoffs. CO4 - Students will be able to use software tools, such as MATLAB to investigate potential solutions to these problems and tradeoffs in order to validate the above analysis, as well as to handle cases not amenable to simple analysis. CO5 - Students gain experience working and learning in a cooperative setting on real hardware where the simplifying assumptions used in theoretical analysis may be violated, and gain an understanding of the benefits and limitations of such analysis.
ELEC 1990	On successful completion of this course, students will be able to: CO1 – use tools or platforms commonly used in the engineering industry CO2 – be well-equipped to enter and become productive members of the work force CO3 – be aware of the professional practices and ethical responsibilities of engineers
ELEC 1991	On successful completion of this course, students will be able to: CO1 – use tools or platforms commonly used in the engineering industry in order to solve engineering and business problems in an efficient, economical, and practical way CO2 – be well-equipped to enter and become productive members of the work force CO3 – be aware of the professional practices and ethical responsibilities of engineers CO4 – gain experience applying their knowledge of mathematics, science and electronic and computer engineering in an industrial setting CO5 – cooperate with people from various disciplines and backgrounds

2000-Level Courses	
ELEC 2100	On successful completion of this course, students will be able to: CO1 – Describe ***Basic Continuous Time and Discrete Time signals*** and different ways to make use of and manipulate them CO2 – List the ***Properties of LTI systems*** and to determine the output of an LTI system using the impulse response and the convolution sum/integral, and the frequency response and transform CO3 – Correctly apply the appropriate transform (FS, DTFS, FT DTFT) to produce a ***Frequency domain representation*** for continuous-time/discrete-time and periodic/aperiodic signals, and relate basic operations in the time and frequency domains CO4 – State and prove the ***sampling theorem*** CO5 – Analyze ***differential and difference equations*** as causal LTI systems and to ***realize*** them in different block diagram forms CO6 – Apply theories learnt to the ***analysis*** of communication systems including Amplitude Modulation and Frequency Division Multiplexing, mechanical systems, and new problems CO7 – Use the ***Software Tools*** Matlab to manipulate, process, analyze and plot signals
ELEC 2200	On successful completion of this course, students will be able to: CO1 – *Analyze, design and debug* basic combinatorial and sequential logic circuits CO2 – *Design and implement* a simple digital system using basic digital logic circuits CO3 – *Design, debug and verify* simple digital circuits and systems with the aid of computer software including VHDL, schematic capture tools and simulation tools CO4 – *Build* a real engineering system following a hierarchical design principle Students will get the opportunity to work in a team environment as well as learn and practice effective project and time management skills.

ELEC 2300	On successful completion of this course, students will be able to: CO1 - Understand the typical computer hardware and software components and computer technology trends CO2 - Understand typical instruction set architecture and assembly programming method CO3 - Use computer arithmetic techniques to represent and process data in computers CO4 - Use typical methods to evaluate computer performance CO5 - Use a typical computer system design flow to systematically develop single-cycle processor architectures including datapath and control for an instruction set CO6 - Systematically develop basic multi-cycle pipelined processor architectures for an instruction set and handle hazards CO7 - Understand memory hierarchies and use cache to handle temporal and spatial locality in programs
ELEC 2400	On successful completion of this course, students will be able to: CO1 - *apply* the fundamental circuit concepts to compute the output of basic electronic circuits in response to a DC input signal. CO2 - *recognize* sinusoidal steady state characteristic of basic electronic circuits using phasors and able to compute the output of basic electronic circuits in response to an AC input. CO3 - *compute* the transient responses of basic electronic circuits consisting of capacitors and inductors. CO4 - *compute* the characteristic of basic electronic circuits consisting of operational amplifiers and diodes. CO5 - *employ* electronic instruments and perform experiments. CO6 - *apply* CAD tools to simulate and analyze electronic circuits.

ELEC 2420	On successful completion of this course, students will be able to: CO1 - recognize basic concepts of electronic components and circuits CO2 - analyze DC, AC and transient behaviors of electronic circuits CO3 - recognize basic logic functions and logic gates CO4 - analyze and design combinational and sequential logic circuits CO5 - employ electronic instruments to perform experiments
ELEC 2600	On successful completion of this course, students will be able to: CO1 - Understand the mathematic basis of probability models and their application to engineering CO2 - Manipulate probability models to solve engineering problems CO3 - Recognize probabilistic experiments and develop relevant probability models for representing such experiments CO4 - Use Matlab as a software tool to manipulate, process, analyze and plot quantities relating to engineering probability models
ELEC 2910	Upon successful completion of this course, students will have had: CO1 – the opportunity to discuss academic and professional matters of both general and individual concern with their advisors. CO2 – the opportunity to express their views on matters related to their study of electronic and computer engineering. CO3 - practice with English communication, in speaking and listening, on both academic and non-academic topics.

3000-Level Courses	
ELEC 3100	On successful completion of this course, students will be able to: CO1 - Understand the modeling of communication links as well as understand why we are interested to study communication systems. CO2 - Be familiar with both mathematical and qualitative concepts regarding analog communication systems as well as digital communication systems. CO3 - Understand the difference, pros and cons between analog and digital communication systems CO4 - Understand how practical communication systems (analog and digital) are designed as well as explaining why these systems are designed that way. CO5 - Understand how to utilize the mathematical tools of random variables and random process to quantify the performance of communication systems under noise. CO6 - Use software tools (such as Matlab) to design and quantify the performance of communication systems CO7 - Apply the concept of signal space to qualitatively explain the design of digital communication systems.
ELEC 3200	On successful completion of this course, students will be able to: CO1 - model simple dynamical systems using differential equations as well as understand the importance of the models in system analysis, synthesis, and simulation. CO2 - manipulate the models of LTI systems in different forms, such as differential equations, transfer functions, and block diagrams, analytically and by CAD tools (such as MATLAB). CO3 - understand feedback as an ubiquitous tool to control a system CO4 - understand the importance of stability in a physical system and understand how to achieve stability using feedback control. CO5 - complete a real feedback control task from modeling, controller design, simulation, and implementation using CAD tools (such as MATLAB). CO6 - understand the robustness and performance issues in a control system and the ways to address these issues.

ELEC 3300	On successful completion of this course, students will be able to: CO1 - *Recognize* the marketing and engineering views of micro-processor and micro-controller applications. CO2 - *Understand* and *analyze* the building blocks of ARM micro-controller based system, and the interfacing techniques of simple external devices. CO3 - *Understand* and *compare* different up-to-date computer interfacing technologies. CO4 - *Use* CAD tools to program and emulate the performance of the micro-controller. CO5 - *Execute* a complete project in team from problem formulation, time management, design/implementation, up to verification and documentation.
ELEC 3400	On successful completion of this course, students will be able to: CO1 - *recognize* the operations of diodes and transistors in integrated circuit functional blocks. CO2 - *distinguish* and *employ* large-signal analysis and small-signal analysis in analyzing a circuit. CO3 - *analyze* and *design* basic CMOS analog and digital building blocks and simple mixed-signal systems. CO4 - *analyze*, *design* and *debug* analog and digital circuit building blocks. CO5 - *apply* software tool, such as Pspice, to design, simulate and analyze integrated circuit functional blocks.

ELEC 3500	On successful completion of this course, students will be able to: CO1 - communicate with the language of semiconductor (diode, BJT, MOSFET, doping, Fermi-level, drift-diffusion etc. CO2 - describe the basic principles of some common circuit active elements plus photo active devices (solar cell, LED, CCD) CO3 - describe the effects of changing the key physical parameters of diode, BJT and MOSFET on the trend (increase or decrease) of the output characteristics CO4 - remember the operation of a cleanroom CO5 - operate a probe-station CO6 - match a given model to measurement data by selecting relevant parameters
ELEC 3600	On successful completion of this course, students will be able to: CO1 – solve the main problems of the electric and magnetic fields distribution for different device constructions, taking into account the boundary problems. CO2 – be familiar with the Maxwell equations both in the integral and differential forms as the fundamental laws of the Electromagnetism and to give a physical evidence that lead to their appearance. CO3 – present a basic description of the electromagnetic wave propagation in various materials, including conductors, dielectrics and magnetic materials. CO4 – apply the basic principles of the electromagnetism to the development of the transfer devices of the electromagnetic energy, such as transmission lines and antennas.
ELEC 3910	Upon successful completion of this course, students will have had: CO1 – the opportunity to discuss academic and professional matters of both general and individual concern with their advisors. CO2 – the opportunity to express their views on matters related to their study of electronic and computer engineering. CO3 - practice with English communication, in speaking and listening, on both academic and non-academic topics.

4000-Level Courses	
ELEC 4010B	On successful completion of ELEC4010b, students will be able to: CO1 – Obtain a holistic view of embedded system design using smart phone as an example. CO2 – Recognize and understand the basic software and hardware components of an embedded system. CO3 – Understand the anatomy of a smart phone and identify the key hardware of a smart phone and software components of a mobile operating system. CO4 – Analyze, design, and debug simple software and hardware components used in an embedded system. CO5 – Experience embedded system design through hand-on experience CO6 – Obtain knowledge and experience in developing real applications on mobile embedded system platform. CO7 – Work in a team environment: learn and practice effective project and time management
ELEC 4010C	On completion of this course, students will be able to: CO1 - Understand the current energy situation CO2 - Formulate a model of energy supply chain using fossil fuels CO3 - Understand the operation of solar cells CO4 - Analyze and simulate operation of solar cells CO5 - Understand the operation of thin film solar cells CO6 - Understand some current technologies related to energy generation
ELEC 4010D	On completion of this course, students will be able to: CO1 - Recognize the importance and necessity of avionics systems in aircraft ranging from single-seat private plane to most modern giant Airbus 380. CO2 - Understand the history and evolution of traditional/analog instrumentation to modern computerized digital display systems. CO3 - Comprehend the four major avionics subsystems and their functionalities including: navigation equipment, electronics, communications, and electrical power. CO4 - Explain the different operating principles of external and internal navigational systems, their pros and cons. CO5 - Acquire knowledge in more advanced features including autopilot, fly-by-wire, and instrument landing. CO6 - Use the above knowledge to supplement their appreciation of “aeronautical engineering”.

ELEC 4010E	On successful completion of the Course, students will be able to: CO1 - Recognize the importance and complexity of modern hi-tech, fast-paced, global projects are manageable through methodical processes and practices. CO2 - Understand project life cycle and important phases in specific sequence in order to apply the proper project management tools. CO3 - Comprehend the five major Project Management essentials. CO4 - Apply the ten key management elements to Project life cycle Management and obtain measurable results. CO5 - Acquire practical knowledge during class in small group exercises and short-term assignments. CO6 - Use the aggregate knowledge to perform effective PM under simulated scenarios.
ELEC 4010F	On successful completion of the Course, students will be able to: CO1 - Recognize the importance and complexity of probabilistic modeling and information processing. CO2 - Acquire first-hand know-how during class about modern robotic platforms such as unmanned aerial vehicles. CO3 - Comprehend fundamentals of basic machine learning techniques by lecture assignments. CO4 - Implement practical algorithms to realize basic perception for robotic systems by projects. CO5 - Enhance the knowledge in computer science, signal processing and practical programming. CO6 - Use the aggregate knowledge to perform robotic tasks to operate simulated robots in simulated scenarios.
ELEC 4010G	On successful completion of the course, students will be able to: CO1 - Have an in-depth understanding of time-domain and frequency-domain methods as well as their relationships in dynamic system modeling, analysis and control. CO2 - Use several techniques for control system design. CO3 - Understand further the importance of feedback and its limitations. CO4 - Skillfully use CAD tools (such as MATLAB and SIMULINK) in control system modeling, analysis and control. CO5 - Equip themselves with experience in controlling real physical systems.

ELEC 4110	On successful completion of this course, students will be able to: CO1 - *Recognize* the key technological developments of digital communications and wireless systems CO2 - *Identify* the fundamental principles related to digital communication technology CO3 - *Use* Matlab to *solve* simple simulation problems in digital communications CO4 - *Comprehend* technical specifications and *understand* how and why practical wireless systems are designed.
ELEC 4120	On successful completion of this course, students will be able to: CO1 - *Recognize* the key technological developments in networking technology CO2 - *Understand* the fundamental principles for constructing a computer network CO3 - *Understand* and develop network programming skills for various applications
ELEC 4130	On successful completion of this course, students will be able to: CO1 - *Understand* the formation and quantification of digital images CO2 - *Understand* the basic principles behind spatial filtering and frequency domain filtering CO3 - *Use* filtering concept to enhance images and restore noisy-corrupted images CO4 - *Understand* the difference between binary images and gray value images, as well as the difference between gray value images and color images.
ELEC 4140	On successful completion of this course, students will be able to: CO1 - understand the BIG background of audio-visual data compression CO2 - be familiar both mathematically and conceptually with the fundamental compression techniques (such as entropy coding, prediction, transform, quantization, etc.) CO3 - apply the most suitable compression technique to a given audio or visual signal CO4 - be knowledgeable to some popular image and video coding standards (such as JPEG, MPEG, and H.264) CO5 - understand why motion information is so important in video coding and how to perform motion estimation CO6 - use software tools, such as Matlab, to implement some practical coding systems

ELEC 4150	CO1 - An ability to apply knowledge of discrete mathematics, probability, and the coding principle to solve communication/storage system design problems CO2 - An ability to use a coding/information theoretic approach to formulate communication/storage system design problems CO3 - An ability to recognise and understand common coding related terminology in technical document and specifications. CO4 - An ability to conduct a presentation and/or complete a course project through teamwork. CO5 - An ability to use software tools to simulate coding schemes and evaluate them based on theoretical bounds and practical system performance measure.
ELEC 4160	On successful completion of this course, students will be able to: CO1 - Understand the fundamentals of human speech sound production and perception systems CO2 - Understand the basic signal processing concepts pertain to speech processing and be able to write Matlab programs for this purpose CO3 - Understand the difference, pros and cons between template based and statistical based speech recognition approaches CO4 - Understand how template based speech recognition works and knows how to implement a basic dynamic time warping algorithm in C/C++ for this purpose CO5 - Understand Hidden Markov Models and pattern recognition concepts and their applications to speech recogntiion CO6 - Implement the Viterbi algorithm in C/C++ for the purpose of word based speech recognition and learns how to analyze the output from the program CO7 - Understand the design principles of large vocabulary speech recognition system and learn the entire process, from data collection and annotation, to design of the system and system evaluation

ELEC 4170	On completion of this course, students will be able to: CO1 - Come up with design concepts of a digital media presentation that demonstrates their insights on a societal issue; CO2 - Analyze and evaluate digital media from artistic, business, and technical perspectives; CO3 - Create digital media (eg. web, image, animation, video) using multimedia tools; CO4 - Adopt online multimedia systems/ networks with their prepared digital media to convey for themselves, companies and organizations.
ELEC 4220	On completion of this course, students will be able to: CO1 - Recognize the history and development of the robotics field CO2 - Identify the basic building blocks of robots and concepts of robotics CO3 - Analyze, design and debug building modules for robots CO4 - Design and build a robot that meets a given set of specifications CO5 - Work in a team environment: learn and practice effective project and time management CO6 - Execute a complete project from problem formulation, design/implementation, up to verification and documentation
ELEC 4310	On successful completion of this course, students will be able to: CO1 - Understand the definition and importance of embedded systems, and its relationships with other systems CO2 - Understand typical embedded system design methodologies, especially hardware/software codesign flow CO3 - Partition embedded applications into hardware and software, and develop architectures for common embedded systems CO4 - Systematically design individual hardware components, such as application-specific processors, for embedded systems, and reuse hardware intellectual properties CO5 - Systematically develop software components for embedded systems, and reuse software intellectual properties CO6 - Use typical embedded system platforms, especially ARM-based system, to design, implement, and test embedded systems

ELEC 4410	On successful completion of this course, students will be able to: CO1 – Recognize the advantages and critical importance of CMOS technology for very-large-scale integration CO2 – Understand the physical structure and operation of digital CMOS integrated circuits CO3 – Use a computer-aided-design tool for developing and characterizing CMOS integrated circuits CO4 – Design and demonstrate high-performance and compact digital CMOS integrated circuits CO5 – Understand the basic principles and current challenges in CMOS technology scaling CO6 – Foresee the evolution of the integrated circuits technology for the next 10+ years CO7 – Manage small-scale group projects CO8 – Demonstrate effective communication skills CO9 – Understand the professional and ethical responsibilities of engineers.
ELEC 4420	On successful completion of this course, students will be able to: CO1 - Be familiar with the basic building blocks of analog integrated circuits, including current and voltage sources, single-gain-stage amplifier, multi-stage amplifiers and operational amplifier CO2 - Analyze and compute mathematically the behaviors of an operational amplifier, including the voltage gain, response time, unity-gain bandwidth and power consumption CO3 - Understand the stability of an amplifier and how to compensation the amplifier to achieve stability CO4 - Use software tools, such as HSpice, to simulate the behaviors of a multi-stage amplifier CO5 - Design a multi-stage amplifier to meet certain constrains, such as supply voltage, power consumption and response time

ELEC 4430	On successful completion of this course, students will be able to: CO1 - *recognize* magnetic quantities such as magnetic flux, permeability and reluctance, and *compute* magnetic quantities relating to inductors and transformers. CO2 - *recognize* and *compute* electrical quantities such as power and work done related to both DC and AC circuits. CO3 - *compute* operating parameters and characterize the performance of power converters and regulator circuits. CO4 - *analyze* and *design* component parameters for power converters and regulator circuits. CO5 - *apply* software (CAD) tools to design, simulate and analyze power converters and regulator circuits.
ELEC 4510	On successful completion of this course, students will be able to: CO1 - Understand the formation and properties of semiconductor materials CO2 - Be familiar with the theory of the electronic structures of atoms and solids CO3 - Be familiar with the energy band and conduction mechanisms in semiconductors CO4 - Associate the electronic structures and band theory to the properties of semiconductor materials CO5 - Understand the physics of excess carries in semiconductors CO6 - Understand the physics and operations of the basic semiconductor devices such as the junction diodes, bipolar junction transistors, and metal-oxide-semiconductor field-effect transistors

ELEC 4520	On successful completion of this course, students will be able to: CO1 - Understand the operation of a cleanroom CO2 - Recognize the basic operation principles of semiconductor fabrication equipment CO3 - Understand the process modules available in IC fabrication CO4 - Design process flows of IC fabrication technologies CO5 - Evaluate effects of process parameters on final transistor characteristics CO6 - Apply the measurement skills for microelectronic devices and IC characterization
ELEC 4610	On successful completion of this course, students will be able to: CO1 - get broad theoretical exposure to fundamental concepts of optics and applications of optical technology, such as nature of light, propagation of light, optical instrumentation and etc. CO2 - get hands-on experience to observe the important optical phenomena experimentally and build a variety of optical instruments by themselves. CO3 - analyze simple optical systems consisting of lenses, stops, reflectors and prisms, determine and use principal points and focal points, and calculate and describe optical aberrations. CO4 - analyze and design systems for measurement of polarization, precision measurement based on interference, optical thin film, interferometer and etc. CO5 - analyze Fraunhofer diffraction patterns, determine the spatial resolution of an imaging system, design optical gratings and build optical spectrometer.
ELEC 4620	On completion of this course, students will be able to: CO1 - Develop fundamental understanding of photonics in the context of optical communications CO2 - Acquire hands-on experience to photonics and optical communications CO3 - Strengthen communication skills via writing bi-weekly lab reports CO4 - Understand the current development in photonics and optical communications

ELEC 4630	On successful completion of this course, students will be able to: CO1 – Understand the distributed nature of components and circuits operating in microwave frequencies, and the need of solving electromagnetic fields for the understanding microwave components and circuits CO2 – Understand the theoretical foundations and concepts of specific microwave components, circuits, and systems CO3 – Derive and understand properties of various microwave passive circuits and components, and learn how to apply these properties for particular designs CO4 – Develop intuitive and physical understanding for microwave phenomenon, and to obtain hands-on experience with microwave components, circuits and testing equipment
ELEC 4640	On completion of this course, students will be able to: CO1 – Understand the wave theory of light CO2 – Perform calculations of diffraction optics CO3 – Use computer programs to simulate optical systems CO4 – Understand the basic principles of holograms CO5 – Understand the principles of Fourier optics and perform calculations CO6 – Understand the physics of lasers and perform computer simulation of the dynamic rate equations
ELEC 4810	Upon successful completion of this course, students will be able to: CO1 - Understand the broad role that an electric engineer can play in biomedical engineering. CO2 - Describe and analyze biomedical applications from electrical, chemical and mechanical engineering perspectives. CO3 - Recognize how engineering and mathematics can be applied to the analysis and constructive manipulation of biological systems and the development of biomedical therapies. CO4 - Design a variety of biomedical instruments via comprehensive labs. CO5 - Work collaboratively in a interdisciplinary setting. CO6 - Undertake more advanced courses in biomedical engineering.

ELEC 4820	On successful completion of this course, students will be able to: CO1 - understand the basic principles of X-ray projection imaging CO2 - understand the basic principles of computed tomography CO3 - understand the basic principles of ultrasound imaging CO4 - understand the basic principles of magnetic resonance imaging
ELEC 4900	On successful completion of this course, students will be able to: CO1 - Recognize the importance and difficulties in applying learned skills/knowledge to solve practical problems CO2 - Understand the steps in solving a practical problem from background research to problem solution CO3 - Execute a complete project from problem formulation, design/implementation, up to verification, documentation and presentation CO4 - Work in a team environment: learn and practice effective project and time management CO5 - Identify the contribution of the project
ELEC 4901	On successful completion of this course, students will be able to: CO1 - Recognize the importance and difficulties in applying learned skills/knowledge to solve research problems CO2 - Understand the steps in solving a research problem from literature review to problem solution CO3 - Execute a complete project from problem formulation, design/optimization, up to verification, thesis preparation and presentation CO4 - Identify the novelty/contribution of the thesis
5000-Level Courses	
ELEC 5900	On successful completion of this course, students will be able to: CO1 -Describe the scientific method for doing research CO2 - Categorize different type of research CO3 - Evaluate the quality of research paper CO4 - Write a research proposal CO5 - Write a review of a research paper CO6 - Identify different components in a published paper