VIETNAM NATIONAL UNIVERSITY, HANOI

VNU UNIVERSITY OF ENGINEERING AND TECHNOLOGY

FACULTY OF ELECTRONICS AND TELECOMMUNICATIONS

THE PROGRAM OF BACHELOR
IN
ELECTRONICS AND COMMUNICATIONS ENGINEERING

COURSE HANDBOOK

2013

Mathematics for ET	
Code	ELT2029
Knowledge Module	Basic
Pre-requisite	MAT1093/MAT
Number of Credits	3 (45/0/0)

In this course, students are equipped with the basic knowledge of algebra (including linear algebra) and calculus, to study in the field of general science and technology. In Electronics & Telecommunications (ET) field, there is always time delay (phase offset) when signals are transmitted between the systems. The time delay is easily expressed in complex domain. Complex analysis is widely utilized to represent and analyze signals and electrical, electronic and telecommunications systems. Besides, in those systems, there is always the existence of various types of random signals, such as noise (temperature impact of electronic components), interference (random effects of other signals in the environment of communication), the transmission and receiving of random information (such as packets in the internet). The knowledge of probability and statistics is served to model the random process, and then implement some related issues such as analysis, processing and evaluation of the quality of the ET system

This course covers two mathematical aspects in depth for ET field: Complex Analysis, and Probability and Statistics. For complex analysis, the subject mentions problems related to complex numbers, such as functional analysis, basis functions, complex integral, series representation of the analytic functions, transformations. For probability and statistics, the subject includes: the probabilistic model, the basic concepts of probability theory, random variables, multiple random variables, and random processes. Moreover, the course also indicates how to apply the theoretical concepts to common applications in ET field.

Data Structures and Algorithms	
Code	INT2043
Knowledge Module	Basic
Pre-requisite	INT1006
Number of Credits	3 (30/15/0)

This module aims to provide students with a good understanding of structures of different data types and various types of computing algorithms. The content of this course consists of following issues:

- Fundamental concepts of algorithms, their complexity and classification.

- Basic data structures such as array, list, stack, queue.

- Sorting and searching algorithms.

- Tree data models, binary tree etc.

- Graph model, graph algorithms

- Techniques of algorithm design.

Signals and Systems	
Code	ELT2035
Knowledge Module	Basic
Pre-requisite	MAT1093/MAT
Number of Credits	3 (42/3/0)

This module provides knowledge and information including classification of signals and systems, basic signals, system models, presentation of linear time-invariant system in time domain. Its content also consists of theory and applications of Fourier transform for presenting signals and linear time-invariant systems are also given; Laplace transform and its application for analyzing linear time-invariant continuous -time systems, Z transform and its application for analyzing linear time-invariant discrete- time systems.

Engineering Professionalism	
Code	ELT2028
Knowledge Module	Basic
Pre-requisite	Nil
Number of Credits	2 (30/0/0)

This module gives students a good understanding of basic knowledge on the professionalism in engineering. Subjects are presented in the form of study guidance and presentations. Students will be divided into small groups to discuss the related issues, which includes of: The Role of Engineering in Society; Academic and Research Ethics; Intellectual Property Rights; Writing Scientific Papers and Presentation Skills; and Basic Leadership in Organization.

Electrical Engineering	
Code	ELT2030
Knowledge Module	Basic
Pre-requisite	PHY1103

Number of Credits	3 (36/9/0)

- This course presents the followings: DC circuit analysis methods and basic theories, AC circuits, phase, resistance, resonance and power factor.
- The theoretical analysis of circuits in transition process and in steady state, frequency response, Bode plot and resonance frequency.
- The electronic part is introduced as basic content for the next course.
- Mechatronics is introduced in order that students continue investigating and write essays.

- Combination of theoretical exercises and experiments allows students to confirm basic principles.

Electronic Devices

Code	ELT2032
Knowledge Module	Basic
Pre-requisite	PHY1103
Number of Credits	3 (36/9/0)

This course presents following contents:

- The concepts of semiconductor physics.

- Semiconductor diodes and their applications.

- Bipolar transistors (BJT): structure, operation principles and biasing method.

- Field-effect transistors (FET): structure, operation principles and methods of polarization.

- Model and operation of the BJT, FET in small-signal mode, frequency response of BJT and FET.

- Transistor circuits.

- Integrated circuits (ICs): Introductions of IC fabrication process, operational amplifiers, power amplifiers, linear ICs

- Other semiconductor devices.

Modeling and Simulation

Code	ELT2031
Knowledge Module	Intermediate
Pre-requisite	INT1006

Number of Credits	2 (20/10/0)

This module aims at providing students a deep understanding of Modeling and Simulation, emphasizing in the field of Electronics and Communications Systems. The contents include of: Models; Types of Models; Simulation; Types of Simulation; Simulation Terminology; Link between Design and Manufacture; Steps to Develop a Simulation; Simulation Tools; Simulation Methodology; Solution for the Analysis Models; Areas that Impact the Study of Communications Systems.

For the practice (10 credit hours ~ 20 hours at Lab): students will use Matlab-Simulink tool for the simulation of communication systems.

Electronics

Code	ELT2033
Knowledge Module	Intermediate
Pre-requisite	PHY1103
Number of Credits	4 (45/15/0)

This course presents the operation principles of basic electronic circuits based on fundamental semi conductor electronic devices such as diodes, transistors and operational amplifiers. The linear analog circuits include the rectifier, waveform modification, single transistor amplifier with common emitter, common base and common collector, multi stage amplifiers, differential amplifiers, etc... The nonlinear circuits include detection circuits, comparison circuits and oscillators. Some basic electronic circuits for communications such as frequency mixing circuit, signal processing circuit and demodulation are also presented. The sample and hold circuit(S &H), the digital-to-analog converter (D/A) and vice versa the analog-to-digital converter (A/D) are also introduced. The last part presents the principle of the power supply voltage including the pulsed regulator circuit.

Digital Design

Code	ELT2034
Knowledge Module	Intermediate
Pre-requisite	PHY1103
Number of Credits	4 (45/15/0)

Modern electronic systems, from digital audio systems to complex computers, are substantially realized using digital logic. This module provides the students with an understanding of the building blocks of modern digital systems and methods of designing, simulating and realizing

such systems. The emphasis of this module is on understanding the fundamentals of digital design across different levels of abstraction from logic gates to hardware descriptions languages. The module will involve assignments based on design, simulation and realization of digital circuits. This course enable students to understand the approaches to modeling and designing of digital circuits viewed as state machines, to see how programmable logic devices can be used to realize digital systems, to gain familiarity with hardware description languages and to appreciate how they can be used to model digital systems.

Engineering Electromagnetics	
Code	ELT2036
Knowledge Module	Intermediate
Pre-requisite	MAT1093/ MAT1094
Number of Credits	3 (42/3/0)

This course provides students with the fundamental knowledge on Electromagnetic Engineering. In details, the knowledge on: Overview of Vector Calculus; Theory of Static Electric Field; Theory of Static Magnetic Field; Theory of Time-Varying Electromagnetic Field; Electromagnetic Waves and Fundamental Theory of Antennas.

For the practice (3 credit hours ~ 6 hours at Lab): students will practice on the measurement instruments, such as Spectral Analyzer, Signal Analyzer to analyze some electromagnetic waves/signals.

Digital Signal Processing	
Code	ELT3044
Knowledge Module	Intermediate
Pre-requisite	MAT1093/ MAT1094
Number of Credits	3 (42/3/0)

The course focuses on analyzing the "filtering" role of a linear time-invariant discrete-time systems and learning about design methods of linear time-invariant filters to meet the requirements in the frequency domain.

The module introduces basic knowledge of discrete signals and discrete systems. The structures for realization of the filters which allow to reduce system resources and system errors are then considered such as direct form I and direct form II, parallel-form, cascade-form of autoregressive moving average model. After having the basic knowledge of discrete systems and filter structure, students will concentrate on studying the design techniques: IIR digital filters from analog Butterworth and Chevbyshev filters by impulse

invariance or bilinear transformation; digital FIR filters by the window method, the frequency-sampling, Parks-McClellan; multirate filters including decimation, interpolation, sampling rate conversion by a rational factor; polyphase filters.

Digital Signal Processing	
Code	ELT3044
Knowledge Module	Intermediate
Pre-requisite	MAT1093/ MAT1094
Number of Credits	3 (42/3/0)

The course focuses on analyzing the "filtering" role of a linear time-invariant discrete-time systems and learning about design methods of linear time-invariant filters to meet the requirements in the frequency domain.

The module introduces basic knowledge of discrete signals and discrete systems. The structures for realization of the filters which allow to reduce system resources and system errors are then considered such as direct form I and direct form II, parallel-form, cascade-form of autoregressive moving average model. After having the basic knowledge of discrete systems and filter structure, students will concentrate on studying the design techniques: IIR digital filters from analog Butterworth and Chevbyshev filters by impulse invariance or bilinear transformation; digital FIR filters by the window method, the frequency-sampling, Parks-McClellan; multirate filters including decimation, interpolation, sampling rate conversion by a rational factor; polyphase filters.

Communications	
Code	ELT3043
Knowledge Module	Specialized - Communications concentration
Pre-requisite	ELT2030
Number of Credits	3 (42/3/0)

This module includes the basic concepts of point-to-point communications mode and communication systems (multi-node, multi-path). Specifically, the course shall equip the students with knowledge of the following topics: The basic concept of transmission, modulation, demodulation of AM, FM, PLL, circuit switching and packet switching, space–time communication, the Erlang formula and cellular network.

Introduction to Microwave Systems and Circuits	
Code	ELT3045
Knowledge Module	Specialized - Communications concentration
Pre-requisite	ELT2030
Number of Credits	3 (39/6/0)

This course introduces fundamental microwave theories and techniques to students. Topics cover: Transmission Line; Smith Chart; Microwave Networks; Microwave Circuits and Devices.

For the practice (6 credit hours ~ 12 hours at Lab):

- Measurement of microwave devices and antennas using a Vector Network Analyzer (VNA).
- Using Ansoft Designer SV to design and simulate some microwave devices and circuits.

RF Communications	
Code	ELT3056
Knowledge Module	Specialized - Communications concentration
Pre-requisite	ELT2035/ ELT3043
Number of Credits	3 (42/3/0)

This module aims to provide students concept and characteristics of the radio channel and design of the transceiver in a wireless environment. Students will also learn the importance of simulation and implementation. The course equips the students with the knowledge of the nature and model of the radio channel, the concepts and techniques in order to reduce the effects of fading and noise, and the applications to wireless communications systems. Topic to be covered includes the physical model and the characteristics of the radio channel (large-scale and small-scale fading, the essential parameters, mathematical model, and statistical model); the transceiver design techniques in order to reduce the effect of fading and noise; detection theory; diversity (time, frequency, space) and evaluation the quality of the system, compared to the AWGN channel. In addition, student will be get familiar with the actual radio communication systems (GSM, CDMA, and OFDM), multiple access and interference management.

Digital Communications and Coding	
Code	ELT3057
Knowledge Module	Specialized - Communications concentration
Pre-requisite	ELT2035/ ELT3043
Number of Credits	3 (42/3/0)

This course presents fundamental concepts and techniques of digital communication including digital modulation and demodulation over AWGN channel, Bit error rate (BER) and channel coding theory to reduce the error probability.

This course content includes the basic concepts of digitals communication: inter-symbol interference (ISI), noise and match filter, the comparison between analog and digital communication, Bit Error Rate, the relation between bandwidth and power, the concept of source coding, channel coding. In addition, the course will also provide the concepts in channel coding, include block code and convolution code; the Shannon theory.

HF Techniques	
Code	ELT3060
Knowledge Module	Specialized - Communications concentration
Pre-requisite	ELT2030/ ELT3045
Number of Credits	3 (36/9/0)

Based on the fundamental knowledge, given in the course Introduction to Microwave Systems & Circuits, this module aims at providing students a deep understanding of HF Techniques, with the following contents: Network Analysis; Impedance Matching; Design of Microwave Filters; Design of Amplifiers, Microwave Circuits; Microstrip Technology.

For the practice (6 credit hours ~ 12 hours at Lab):

- Using Smith Chart for impedance matching with L-Network and Microstrip Lines.

- Using ADS to design and simulate Microwave Filters and Amplifiers.

- Measurement of Filters and Amplifiers using a Vector Network Analyzer (VNA) and s Spectrum Analyzer.

Computer Communications Networks 1	
Code	ELT3046
Knowledge Module	Specialized - Networking concentration

Pre-requisite	ELT2030
Number of Credits	3 (42/3/0)

This module presents details of architecture models of computer communications networks. Students will learn the roles and functionalities of model layers as well as necessary technical terms and concepts regarding to communications protocols implemented in different layers of computer communications networks. The content of this module will focus on technology issues of TCP/IP model in order to prepare strong background of students for other related modules.

Switching Techniques

Code	ELT3050
Knowledge Module	Specialized - Networking concentration
Pre-requisite	ELT2030
Number of Credits	3 (42/3/0)

The course presents aspects of digital communications via circuit-switched and virtual circuit-switched networks in order to introduce techniques of circuit and virtual circuit transmission (including TDM and ATM), other switching techniques and protocols of network control (signaling). Hereafter, students will know how to set up a network and manage the current network as well as next generation network (NGN)

Computer Communications Networks 2

Code	ELT3062
Knowledge Module	Specialized - Networking concentration
Pre-requisite	ELT2030
Number of Credits	3 (42/3/0)

The course contains fundamental knowledge in term of theory: methodology of OSI Model, principles of data link, optimization, error detection and error control to get expected reliability and to reduce the complexity of the algorithm. The course helps students understanding and using various methods of multi-access, congestion-solving problem to improve network performance with two typical protocols: S-Aloha and P-Aloha. Students will also understand the impact of network topology, transmission method that leads to routing problems with aims to ensure network throughput and service quality.

Network Modeling and Simulation	
Code	ELT3063
Knowledge Module	Specialized - Networking concentration
Pre-requisite	ELT2031/ ELT3046
Number of Credits	3 (36/9/0)

This module presents theory, process and methodology for doing communications network modeling and simulation. Students will be equipped basic knowledge of discrete event simulation, statistics applied for network performance evaluation.

Various modeling techniques used for evaluating performance of different network types are also introduced. Typical network simulations tools are introduced and students select the most appropriate tool for their mini project which is considered as a part of the course assessment.

Optical Communications	
Code	ELT3067
Knowledge Module	Specialized - Networking concentration
Pre-requisite	PHY1103
Number of Credits	3 (42/3/0)

The content of the course consists of general knowledge of optical communications such as its evolution history, background of optical data transmission and typical characteristics of optical elements, principles of setting up an optical network. The course equips students knowledge of optics theory, aperture, diffraction, electro-magnetic wave, wave equations, group velocity, dispersion/polarization, resonant hole, integrated optics, waveguide, step-index fiber or graded-index fiber, modes in optical fiber; components of optical network, Optical Multiplexor, Optical Amplifier, Optical transmitters (LED, Laser Diod…), Optical Receivers (photomultipliers, photodiodes, APDs). Design concepts of WDM, components of optical networks and optical switching are also presented in the scope of this course.

Computer Architecture	
Code	ELT3047
Knowledge Module	Specialized - Computer Engineering concentration
Pre-requisite	INT1006

Number of Credits	3 (42/3/0)

This course helps students having the basic knowledge of computer and processor architecture. It supplies concepts of instruction set, methods to perform arithmetic and logic as well as the characteristics of the fabrication of VLSI chip for computer hardware. Students will learn to design a single-cycle processor with simple instruction set. Next, they will learn about how to design a high-performance processor with pipe line technique. The course also introduces the structure and design of the hierarchy memory and peripheral devices of modern computer systems.

Microprocessor Systems

Code	ELT3048
Knowledge Module	Specialized - Computer Engineering concentration
Pre-requisite	ELT2030
Number of Credits	3 (36/9/0)

- Basic hardware architect Microprocessor, the role of the bus, the function of blocks in the microprocessor, command architecture, etc.

- The peripheral device, I/O interface, the communication protocol, the standard I/O bus, digital and analog coupling, build the control programs

- Applications of microprocessors in different areas of Electronics and Telecommunications.

Embedded Computer Systems Design

Code	ELT3069
Knowledge Module	Specialized - Computer Engineering concentration
Pre-requisite	ELT2034/ ELT3047
Number of Credits	3 (36/9/0)

This module provides contents from basic to advanced knowledge, between theory and practice, helping students grasp the basics of embedded computer systems. Specifically, the course equips students with the knowledge related to: The concept embedded computer systems, embedded computing, computer systems as bus communication architecture, design structure of the program and data, multi-core processors and embedded computer platforms, software analysis and design, operating system, system performance, system design and integration ...

Real-time Embedded Systems	
Code	ELT3071
Knowledge Module	Specialized - Computer Engineering concentration
Pre-requisite	ELT2034/ ELT3047
Number of Credits	3 (42/3/0)

The objectives of this module are to present the theoretical foundations of real-time systems and to discuss the practical aspects of their implementation. It describes the characteristics of a real-time computing system and students are taught how to design a real-time embedded system using structured data flow methodology. Concepts of time-critical I/O and real-time deadlines are emphasized, as are the important aspects of real-time operating systems, scheduling and the practical implementation of embedded systems and firmware. Other topics covered include deadlock management and process communications. Various case studies on industrial real-time systems will be exhibited to give students a real-world feel for such systems. Students will undertake a mini project involving a real-time embedded system. Topics covered: Introduction to real-time and embedded systems; Time critical I/O handling; Real-time embedded software design; Concurrent programming; Real-time operating systems; Scheduling and time-critical processing; Deadlock management; Process communications; Case studies of real-time embedded systems.

Integrated Circuit Design	
Code	ELT3079
Knowledge Module	Specialized - Computer Engineering concentration
Pre-requisite	ELT2034
Number of Credits	3 (42/3/0)

This module introduces the students to the design of integrated circuits. It covers basic concepts including integrated circuits fabrication technology, CMOS and nMOS design, inverter design, aspect ratios of pull-up and pull-down transistors, switching characteristics of CMOS and nMOS inverters, latch-up, stick diagram, design rules, mask layout, sub-systems design, ASIC challenges and issues, ASIC design flow, Verilog hardware design language basics, and logic synthesis. Each student will do a design exercise using the EDA tools.

Control Techniques	
Code	ELT3051
Knowledge Module	Specialized - Control and Automation
Pre-requisite	ELT2030
Number of Credits	3 (42/3/0)

The mathematical model of the physical system (the transfer function model and the state space). Feedback systems: characteristics and stability. Laplace transform, transfer function, finding the zero and pole. The properties of control system on the time domain. Performance of the system: transient response and steady state of the system. Root locus, frequency response, Bode diagram, Nyquist stability. Stability margin: gain margin and phase margin.

Digital Control Systems	
Code	ELT3049
Knowledge Module	Specialized - Control and Automation
Pre-requisite	ELT2030
Number of Credits	3 (42/3/0)

This module provides with control theory, analysis and design methods in continuous and discrete time domain. It is the first course introduces concept and classification control systems based on signal nature and system structure; modeling methods for LIT system, digital control system and control system in state space; stability analysis methods for each kind of control system; root locus and frequency response method; feedback control system design using compensating techniques on s plane and Bode diagram; digital control system analysis and design. Above knowledge is illustrated in some applied examples about practical control system. Matlab is good tool to analysis, design and simulate control systems.

Control Systems Design and Simulation	
Code	ELT3073
Knowledge Module	Specialized - Control and Automation
Pre-requisite	ELT3047/ ELT3049
Number of Credits	3 (36/9/0)

This module provides basic knowledge about control system: concept, classification, specificity and process to design a control system. Modeling

methods and some common problems in modeling are concerned. Next contents are analysis and design methods in frequency domain, state space and digital control system. Some examples about practical control system such as controlling speed of DC motor, the angle of arm joint, the pose of satellite or the liquid temperate in the tank…are analyzed, designed and simulated. Some basic commands, Control System Toolbox and Simulink in Matlab are introduced.

Advanced Control Systems	
Code	ELT3075
Knowledge Module	Specialized - Control and Automation
Pre-requisite	ELT3047/ ELT3049
Number of Credits	3 (42/3/0)

This module provides knowledge to analysis and design advanced control system. Beginning introduces concepts, classifications and mathematical tools using in advanced control system. State variable method is for modeling and design control systems in time domain. Some basic theories are to analysis and design non-linear control system. The concept, classification and design optimal control system are concerned. Theory of adaptive and robust control systems is also mentioned. Some modern control methods such as fuzzy logic, neural network, artificial intelligence and genetic algorithm are introduced. Matlab is used to analyze and design control system.

Smart Robot Systems	
Code	ELT3077
Knowledge Module	Specialized - Control and Automation
Pre-requisite	ELT3047/ ELT3049
Number of Credits	3 (42/3/0)

This course helps students having the basic concepts of intelligent robot. Understand the model designed for an intelligent robot, depending on the level of intelligence is required. The major contents of the course focuses on understanding the structure and mode of operation of the intelligent mobile robot in self-management activities. The modern sensors had been used in robot for sensing with interference models and combination methods for increasing the reliability of the estimate robot position. The modern methods used for robot positioning and navigation are presented in detail. The last part of the course presents the general features of the distributed autonomous robotic system such as multi-robot system networked with a number of computational tools such as genetic algorithms or particle swarm

optimization.

Practice (3 credit hours ~ 6 hours at Lab) includes:

- Robot simulation with the ROBOSIM.

- Robot multi-sensor Trilobot.

- Research Lego Midstorms kit.

System Design Laboratory (*lab project*)	
Code	ELT2037
Knowledge Module	Projects/ Thesis
Pre-requisite	Nil
Number of Credits	4 (12/36/12)

This module is designed in order to drill students skills of simulation design and experiment measurement of analog and digital electronic circuits applied in transceiver devices, signal processing, automatic control etc.

Students are formed in groups of 3 to 5 members. Each group selects a mini project to design a electronic circuit or device. Using simulation and design tools, students build design ideas and then implement them as hardware products. Each group will present their project in an oral presentation in which they describe their design ideas and obtained results.

Project and System Engineering (*industrial project*)	
Code	ELT2038
Knowledge Module	Projects/ Thesis
Pre-requisite	Nil
Number of Credits	4 (12/0/48)

This module is carried out in the form of internship in which students will join ongoing works of companies in order to understand product design process, operation of a system and economy aspects. Each student proposes a practical project for which he/she will investigate how a product is designed and released as a commercial good. They will also study the operation and management of a practical system. It is also a good chance for students to learn and practice soft skills in terms of teamwork as well as understand business manner.

Graduation Thesis	
Code	ELT4053
Knowledge Module	Projects/ Thesis
Pre-requisite	Nil
Number of Credits	10 (0/0/0)
Graduation thesis is a research-based project in which students will study deeply a research topic, find open problems and propose solution(s) to solve the problem(s).	