Electronic Engineering

Electronic engineering is concerned with the generation, transmission and utilization of electrical energy and with the transmitting and processing of information. Electronic engineers are involved in the analysis, design and production of electric power, radio, radar, television, computing, telecommunication, control and information systems. These engineers find solutions to the challenging technical problems that arise in our rapidly changing society. They impact virtually every aspect of daily life, as evidenced by examples such as wireless communications, audio and video equipment, power distribution, computerized traffic control, noise pollution monitoring and abatement, and medical instrumentation.

The electronic engineering curriculum puts emphasis on both theory and practical applications by providing a solid background in engineering science and mathematics, followed by a sequence of core courses in electronic engineering.

Design skills are fostered in the professional elective courses in the junior and senior years, along with the project experience instilled by a series of Engineering Innovation Design (EID) projects (I – VI).

The objectives of the undergraduate electronic engineering program are to produce electrical engineering graduates who are prepared to:

- Enter their profession and make intellectual contributions to it
- Embark on a lifelong career of personal and professional growth
- Take advanced courses at the graduate level

UNIVERSITAS MERCU BUANA &
BEIJING INSTITUTE OF TECHNOLOGY

北京理工大学 **Beijing Institute of Technology**

电子科学和技术专业教学计划-Electronic Engineering Curriculum

Semester 1			**Credits**
ENG24198	英语听说	Intensive English Training	3
MTH17003	工科数学分析 I	Calculus and Differential Equation I	6
MTH17012	线性代数 A	Linear Algebra A	3
CHM17024	大学化学 C	General Chemistry C	2
COM08075	计算机技术与编程（英文）	Computing Science and Programming	3
POL22003	思想品德修养与法律基础	Morals, Ethics, and Laws	3
POL22001	中国近现代史纲要	Modern Chinese History	2
LAW23005	知识产权法基础	Law of Intellectual Property Rights	1
MAC03002	工程制图基础（英文）	Fundamentals of Engineering Drawing	2
GYM32001	体育 I	Physical Education I	1
INF05001	电子工艺实践（英文）	Practice in Electronic Technology	1.5
MIL98001	军事理论	Military Theory	1
MIL98002	军事训练	Military Training	1.5
Total Hours			**30**

Semester 2			**Credits**
ENG24199	英语写作	English Composition	3
MTH17004	工科数学分析 II	Calculus and Differential Equation II	6
PHY18005	大学物理 I	General Physics I	4
PHY17018	物理实验 B I	General Physics Labs B I	1
COM08076	C 语言编程实践	C Programming Practice	1
POL22004	大学生心理素质发展	Psychology Education	1
POL22002	毛泽东思想与中国特色社会主义概论	Chinese Government and Politic Issues	4
GEN99001	通识教育选修课	General Electives	2
INF05164	工程创新设计 I	Engineering Design I	1
GYM32002	体育 II	Physical Education II	1
POL22008	人文社会实践	Humanities	2
Total Hours			**26**

Semester 3			Credits
POL22017	马克思主义基本原理	Basic Theory of Marxism	3
MTH17037	概率与数理统计	Probability and Statistics	3
PHY18004	大学物理 Ⅱ	General Physics II	4
PHY17019	物理实验 B Ⅱ	General Physics Labs B II	2
MAC03229	工程概论（英文）	Introduction to Engineering	1
GEN99001	通识教育选修课	General Electives	2
ELC05185	电路分析基础（英文）	Fundamentals of Electric Circuit Analysis	3.5
ELC05186	电路分析实验（英文）	Electric Circuit Analysis Lab	1
ELC05187/8	电子实习（英文）(Ⅰ～Ⅱ)	Practice in Electronics (I~II)	2
INF05062	认知实习	Cognition Practice	1
INF05165	工程创新设计 Ⅱ	Engineering Design II	1
Total Hours			**23.5**

Semester 4			Credits
GEN99001	通识教育选修课	General Electives	2
MTH17036	复变函数与积分变换	Complex Function and Integral Transform	2
MTH17041	数理方程与特殊函数	Equations of Mathematical Physics and Special Functions	2
INF05170	算法与数据结构（英文）	Algorithm and Data Structure	2
INF05200	信号与系统（英文）	Signals and Systems	4
ELC05175	模拟电路基础（英文）	Fundamentals of Analog Circuits	3.5
ELC05174	模拟电路实验（英文）	Analog Circuits Lab	1.5
INF05166	工程创新设计 Ⅲ	Engineering Design III	2
Total Hours			**19**

Semester 5			**Credits**
ELC05178	控制理论基础（英文）	Fundamentals of Control Theory	3
ELC05176	数字电路（英文）	Digital Electronics	3.5
ELC05179	数字系统设计与实验（英文）	Digital Electronics Lab	2
ELC05177	电磁场理论与微波工程（英文）	Theory of Electromagnetic Fields and Microwave Engineering	4
ELC05180	数字信号处理（英文）	Digital Signal Processing	3
ELC05181	通信电路（英文）	Communication Circuit	3
ELC05182	通信电路实验（英文）	Communication Circuit Lab	1
INF05167	工程创新设计 Ⅳ	Engineering Design IV	2
ELC05183	课程设计（英文） Ⅰ	Project I	3
Total Hours			**24.5**

Semester 6			**Credits**
INF05191	随机信号分析（英文）	Random Signal Analysis	3
INF05192	数字通信原理（英文）	Principles of Digital Communication	3
COM05115	计算机原理与应用（英文）	Computer Principle and Application	3.5
INF05193	数据通信与网络（英文）	Data Communication and Networking	2
INF05194	半导体物理与器件建模（英文）	Semiconductor Physics and Device Modeling	3
INF05168	工程创新设计 Ⅴ	Engineering Design V	2
INF05197	课程设计（英文） Ⅱ	Project II	1
INF05198	课程设计（英文） Ⅲ	Project III	1
Total Hours			**18.5**

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Semester 7			**Credits**
INF05195	模拟集成电路分析与设计基础（英文）	Analysis and Design Basics of Analog Integrated Circuit	4
INF05196	超大规模集成电路设计（英文）	VLSI IC Design	4
INF05190	毕业实习	Graduation Project	3
INF05169	工程创新设计 Ⅵ	Engineering Design VI	2
	专业选修课	Technical Electives	6
Total Hours			**19**

Semester 8			**Credits**
MAC03027	制造技术基础训练	Basic Training of Manufacture	2
	毕业设计（论文）	Bachelor's Thesis	12
Total Hours			**14**
Total Credit Hours			**174.5**

Course Descriptions

COM05115 Computer Principle and Application

This course introduces the architecture and design technology of processor-based digital systems. The course will cover the following issues which are required to be mastered by the students: Basic concepts of computer, computer families and developments, organization of a real computer system, microcomputer bus structure, central processing unit, and the general assembly coding tools for Intel 80x86 CPU; Computer memory system, static random access memories, read only memories, flash memory and memory system structure and design; General I/O interface technologies, parallel interface, timer/counter, serial Interface, DMA, A/D and D/A; Interrupts and programmable interrupt controller.

Laboratory works will address key issues in processor-based system design implementation, include analog and digital circuits; input/output interface technologies and devices; familiarization with interface controllers; extensive use of assembly language programming.

Prerequisite(s): Fundamentals of Analog Circuits, Digital Electronics, Project I

ELC05174 Analog Circuits Lab

Students will implement analog circuit using transistors or operational amplifiers; design an analog amplifier for specific applications; analyze the relation of the characters of an amplifier; analyze and design a rectifier and voltage regulator. Electrical measurement devices will be extensively used through the lab work.

Prerequisite(s): Fundamentals of Analog Circuits

ELC05175 Fundamentals of Analog Circuits

This course is about analyze and designs of analog electronic circuits. It will cover linear and nonlinear electronic circuits containing diodes and transistors, biasing, small signal models, frequency response, and feedback, differential input stages, output stages, and amplifier stability, designing circuits using operational amplifiers. After completing this course the students should be able to analyze and design basic analog circuits.

Prerequisite(s): Fundamentals of Electric Circuit Analysis

ELC05176 Digital Electronics

The course includes the following chapters: fundamentals of digital circuits, number system, boolean algebra, Karnaugh maps, logic gates, arithmetic circuits, flip-flops, counters, registers, memory and finite state machine.

Prerequisite(s): Fundamentals of Electric Circuit Analysis, Fundamentals of Analog Circuits

ELC05177 Theory of Electromagnetic Fields and Microwave Engineering

This is an introductory undergraduate level course related to the area of Electromagnetic Theory and Microwave Engineering. Based on the intuitive knowledge from General Physics electromagnetic part, the Electromagnetic Theory was derived according to the theory from scratch via advanced mathematics. It covers the fundamental principles of electromagnetism: vector fields, electro- and magneto- statics, electric and magnetic properties of materials, time varying fields,

Maxwell's equations, radiation and propagation of electromagnetic waves, and antenna and antenna system design. Based on the knowledge of Electromagnetic, the teaching of the Microwave Engineering part provides the essential information which distinguishes a microwave engineer apart from a "normal" electrical engineer. A detailed explanation on the fundamental concepts of Microwave Engineering as well as real examples will be given. The students will be required to know transmission line theory, microwave network theory, microwave components, microwave circuit design, and microwave measurement techniques. This course will be taught completely in English, exposing the students to a full English learning environment and preparing them to communicate with foreign professionals in the area.
Prerequisite(s): General Physics (I, II), Calculus and Differential Equation (I, II)

ELC05178 Fundamentals of Control Theory

The course introduces the basic theories of classical and modem control including:
Modeling of dynamic systems: differential equations models, transfer function, state space models, block diagram models, signal flow graph models, relationship between the various models.
Analysis of control systems characteristics with time-domain analysis, root locus method and frequency response: stability, transient response, steady state response, controllability analysis, observability analysis, solving the state equation.
Design of control systems: design method in frequency domain, state feedback design, observe design.
This course will provide the students with the necessary knowledge in system control and help the students to develop the skills of analyzing and solving problems.
Prerequisite(s): Calculus and Differential Equation (I, II), Signals and Systems, Fundamentals of Electric Circuit Analysis.

ELC05179 Digital Electronics Lab

The mandatory course is for the students who study in School of Information and Electronics. It is to introduce the students to master the design methods and practical skills for constructions of reliable digital systems by using MSI and SSI integrated circuits. To complete this course, students should know the skill of using oscilloscope to view waves from digital circuits. They should also understand the function table of various SSI and MSI and use them to construct required combinational circuits (ENCODER, MULTIPLEXER, DECODER/DEMULTIPLEXER, HALF/FULL ADDER and COMPARATOR) and sequential circuits (COUNTER, SHIFTER etc.).
Prerequisite(s): Digital Electronics

ELC05180 Digital Signal Processing

This course is designed to give students a thorough understanding of techniques needed for the analysis of discrete-time signals and systems. This course is to introduce signals and systems in discrete time; the analysis of discrete signals via discrete Fourier transform; the study of fast Fourier transform algorithms; design and implementation of IIR and FIR digital filters. Computer simulations using MATLAB will be required in the laboratory.
Prerequisite(s): Signals and Systems

ELC05181Communication Circuit

This course is about the basic analog communication and intended for students of electronics engineering. The course is to explorer the analysis of some nonlinear circuits in analog communication system, such as resonant power amplifier circuit, LC oscillator, mixer, frequency

synthesizers (PLL) etc. Other important contents offered by this course are analog modulation schemes, the radio transmitters and receivers associated with these techniques. After completing this course, students should be able to analyze analogy communication system and circuits in the radio-frequency field.
Prerequisite(s): Fundamentals of Electric Circuit Analysis, Fundamentals of Analog Circuits, Signals and Systems

ELC05182 Communication Circuit Lab

The lab work is based on nonlinear circuit modules including Colpitts oscillators, amplitude modulation and demodulation, mixer, phase detector, and phase-locked loops. The lab work will let students to know the way to use the measurement equipments, and be able to analyze the data of lab results.
Prerequisite: Communication Circuit

ELC05183 Project I

This course introduces computer programming at the assembly language level, as a means of exploring some basic concepts of microcomputer architecture, system software and peripheral hardware. The course will cover the following issues which are required to be mastered by the students: Data representation, Basic computer system organization, Addressing modes, Assembly language instruction set for the Intel 80x86 families, Assembler directives, I/O, System calls, Assembly language program structure, Macros, Advanced assembly language programming etc.
Laboratory experiments include the Usage of MASM and DEBUG; Designing program with loops and decision making; Designing program for character strings; Keyboard input and screen display; Writing and reading files; Designing program for data array.
Prerequisite(s): Computing Science and Programming, C Programming Practice

ELC05185 Fundamentals of Electric Circuit Analysis

This course introduces the basic concepts, basic theories, and basic analysis methods of the linear circuit. The course systematically introduces electric circuit model, Kirchhoff's law, circuit theorems, and equivalent transformation of circuit model, basic analytical method of linear resistance electric circuit, the ideal operational amplifier circuit, the transient analysis of first-order circuits, the transient analysis of second-order circuits, the steady-state analysis of sinusoidal circuit, calculation of three-phase circuit, the analysis of circuit with mutual inductance. Students will get the basic ability to analysis DC and AC linear circuits.
Prerequisites(s): General Physics (I, II), Calculus and Differential Equation (I, II)

ELC05186 Electric Circuit Analysis Lab

The primary content of this course includes analysis of electromagnetic behaviors in the circuit, exploring and verifying the basic laws as well as analysis methods of electric circuit and learning of its design. This course can help students to develop scientific thinking skills and capacity of experimental research and scientific induction.
Prerequisite(s): Fundamentals of Electric Circuit Analysis

ELC05187 Practice in Electronics I

The goal of the course is to offer students manufacturing process knowledge and lab skills including welding, assembling, and testing based through implementing a MP3 digital player.

The course will start by introductions to a mono-chip processor, and schematic diagram of a MP3 decoder. Lab and manufacturing skills to be offered including SMT, reflow soldering, welding by hand, and the use of a multi-meter during the lab work.

ELC05188 Practice in Electronics II

The course will let students to know about the circuit and working principle of PJ - 80 type radio direction-finding receivers. To know how to receiving signal and how to identify the radio call sign; To understand the principle of functional direction finder, including high frequency amplification circuit, diode mixer circuit, oscillation circuit, audio amplification and power amplification circuit; To know Welding, debugging and measurement and the direction finding circuits in the PJ-80 direction finder.

INF05164-9 Engineering Design I-VI

This is a lab work serials through four-year study of electronics and communications. The course follows the pedagogical concept of CDIO (Conceive Design Implementation and Operation). Six projects will be offered by the course covering skills training for software development and hardware development. Training of software design skills starts from programming basic software modules to program integration and implementation. Training of hardware design skills includes design based on COTS (Commercial Off The Shelf). Part of COTS will be replaced by self-designed IC. Finally, system integration skills will be gained during the final project integration.

INF05170 Algorithm and Data Structure

This course presents fundamental concepts in data structure and algorithm analysis. It provides students an opportunity to further develop and refine their programming skills. The focus of this course is the implementation of common data structures such as lists, stacks, queues, trees and graphs. It also gives the analysis and implementation of searching and sorting algorithms. After completing this course, students should be able to use and implement fundamental data structures, design solutions to problems requiring complex data structures.
Laboratory works include Using linked list solving The Josephus problem; Solveing N queens problem; Adapting stack to simulate desk calculator; implementing Binary search tree; Implementing Insertion sort, Shellsort, heapsort and quicksort algorithm.
Prerequisite(s): Computing Science and Programming, C Programming Practice

INF05190 Graduation Project

This course is designed to give students experiences to propose, design and implement a project. This could be a study of a problem and solution of specific equipment, a new product design, the improvement of an existing product (re-engineering). All projects must be approved by a defense committee.
Prerequisite(s): Completion of the first seven semesters' coursework

INF05191 Random Signal Analysis

This course covers the topics of random signal and noise, and is designed to provide the students an introduction to the concept of stochastic process. Key topics include cumulative distribution function, probability density function, characteristic function, moments, strict- and wide-sense stationary and cyclostationary random processes, noise equivalent bandwidth, correlation function, power spectra density, band-limited narrowband random processes

Prerequisite(s): Probability and Statistics, Signals and Systems

INF05192 Principles of Digital Communication

The course is designed to provide students with a sound fundamental education in the areas of digital communications. The main contents include spectral analysis; random signal theory; information theory; digital transmission through AWGN channels; digital carrier-modulation schemes; error control coding; optimum receivers; carrier and symbol synchronization; spread spectrum and multiuser communications.
The laboratory work will help students understand the fundamental concepts in digital communication systems, and enhance the comprehensive apprehension ability as well.
Prerequisite(s): Random Signal Analysis, Signals and Systems

INF05193 Data Communication and Networking

The course will focuses on the fundamentals of data communication and networks. One goal is to give insight into the rationale of why and how networks are structured,current systems and to understand the issues facing to the designers next-generation data networks. Another goal is to train students' skills to analyze and to solve communication and networks problems.
The course is organized with the TCP/IP model, and lectures are arranged in order of Physical Layer, Data Link Layer, Network Layer, Transport Layer, and Application Layer.
Through the course, students will understand the network structure and how it works.
Prerequisite(s): Algorithm and Data Structure, C Programming Practice

INF05194 Semiconductor Physics and Device Modeling

The course introduces the fundamentals of semiconductor and the models of microelectronic devices for silicon integrated circuit designs. The topics covered include: electron state in semiconductors, carrier statistics in equilibrium, carrier transport, non-equilibrium excess carrier, P-N junction, metal-oxide-semiconductor field-effect transistor and model, bipolar junction transistor and model. The course emphasizes on physical understanding of basic semiconductor concepts and application of device models.
Prerequisite(s): General Physics (I, II), Fundamentals of Analog Circuits

INF05195 Analysis and Design Basics of Analog Integrated Circuit

This course will focus on the analysis, design, and simulation of analog integrated circuits and systems in CMOS technology. The course begins with a brief review of MOSFET operation and large and small signal analyses models. Much of the course will involve the design and analysis of analog building blocks such as current mirrors, operational amplifiers, feedback amplifiers, and bandgap reference. Simultaneously, the course will cover layout techniques, low voltage/power design issues, and system analysis. A final project of designing a high-performance op-amps using 0.18□m CMOS technology will be required.
Note: This course is for senior EE students.
Prerequisite(s): Fundamentals of Analog Circuits, Semiconductor Physics and Device Modeling

INF05196 VLSI IC Design

MOS I-V features, MOS C-V features, the model of delay, CMOS process, combination circuit, sequential circuit, setup time, hold time, the relationship of power consumption and the circuit parameter, design flow of VLSI, tests and verification methods of VLSI, the IC design engineering method and etc.

Prerequisite(s): Fundamentals of Analog Circuits, Digital Electronics, Semiconductor Physics and Device Modeling

INF05197 Project II - Digital System Design Lab

First the digital system design method is introduced. Then the students are requested to design a digital system. Finally students shall implement the designed system in laboratory.
Prerequisite(s): Fundamentals of Electric Circuit Analysis, Digital Electronics, Fundamentals of Analog Circuits

INF05198 Project III - Communication System Design

This course is to design and implement a digital-analog mixed system. Topics include the design of PLL frequency synthesizer and the design of infrared remote-control transmitter/receiver. It is designed to enhance the understanding of the real analog communication system and learn about the basic method of the entire design. During the implementation of the circuit, it can improve the students' analytic and problem-solving skills.
Prerequisite(s): Communication Circuit

INF05199 Practice in Electronic Technology

Introducing the method of selecting and measuring of electronics components which includes resistor, capacitor, inductance, diode, transistor etc.; to get use to the measurement method of common instruments, including digital multimeter and digital oscilloscope; mastering welding skills; training the basic skills of identifying and designing of circuits ; training basic skills of circuits of measurement and debugging; knowing about the working principle of the 555 timer and the basic working principle of monocular television.

INF05200 Signals and Systems

This course covers the fundamentals of signals and systems analysis, focusing on Fourier representations, Laplace and Z transforms. Signals of discrete-time and continuous-time are discussed. Time-invariant systems expressed by difference and differential equations are presented by block diagrams, system functions, poles and zeros. Essential concepts such as convolution, impulse and step responses and frequency responses are also provided. Applications are drawn broadly from engineering and physics, including communications, and signal processing.

INF05201 Signals and Systems Lab

This Course is the lab work of Signals and Systems. In this course we attempt to integrate MATLAB with traditional topics in Signals and Systems so that it can be used to explore difficult topics and solve problems. This course can be used as a supplement in undergraduate courses on signal processing. In this course MATLAB techniques are introduced to model and analyze Signals and Systems. The following is a list of topics which are discussed in this course: Introduction of MATLAB, Time-domain analysis of Signals and Linear Systems, frequency-domain analysis of Signals, sampling, Continuous-time systems analysis in frequency-domain and complex frequency-domain, Discrete-time systems analysis in frequency-domain and z-domain, Lossless transmission system, Modulation and demodulation, Modeling and Simulation of continuous-time systems using Simulink.
Prerequisite(s): Signals and Systems

INF05206 Electronic Communication Systems

The course is an elective course for electronics engineering, communication engineering, and electronic science and technology majors. It is designed to prepare students for modern telecommunication industry. Topics includes: the basic principles and components of Data communication and Internet, Microwave communication, Satellite communication, Telephone communication, Optical communication, Cell-phone and Wireless Communication systems.
Prerequisite(s): Principles of Digital Communication

INF05207 Design and Verification of Embedded System

This course gives an introduction to the design of embedded computer systems including analysis, design and implementation of embedded computer hardware and software; Issues about embedded component selection, hardware/software partitioning, hardware design, and software design will be discussed. Lots of industry embedded system examples will be discussed. Learning may be supplemented with periodic guest lectures by embedded systems engineers from industry. Depending on the interests of the students, other topics may be covered.
Prerequisite(s): Digital Electronics, Computer Principle and Application

INF05208 Theory for Signal Processing, Communications and Control

Classical estimation (Deterministic parameter), Cramer-Rao Lower Bound, Least Squares Estimation, Minimum Variance Unbiased Estimation and Maximum Likelihood Estimation. Bayesian estimation (Random Parameter), Minimum Mean Square Estimation and Maximum A Posteriori Estimation. Kalman Filtering. Estimation Theory in Practice applications.
Prerequisite(s): Signals and Systems, Digital Signal Processing

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