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Curriculum for the Bachelor Degree in Electrical Engineering/ Network systems and Security

Courses Description

BSE0205	Engineering Drawing	2(0-6)
Drawing instruments and their use, lettering, geometric construction, dimensioning, free-hand sketching, Orthographies, isometric projections, sketching and sectioning. Computer drawing using autocad (AutoCAD), engineering applications.		
Prerequisite: CS101		
BSE0102	Engineering Workshop	1(0-3)
Occupational safety and health in engineering workshops, mechanical forming of metals, machining operations, welding processes, carpentry works, electrical installation.		
Prerequisite: -		
BSC0401	Engineering Economy	3(3-0)
Engineering Economy: engineering economic concepts; interest formulas; decision making using present worth, future worth, annual worth, internal rate of return and benefit- cost ratio methods; payback analysis; depreciation.		
Prerequisite: 80 credit hours		
BSE 0201	Programming for Engineers	3(2-3)
This is a fast-paced introductory course to the C++ programming language. It is customized for the engineers with a little programming background. It covers C++ programming concepts, variables and basic data types, control structures and loops, functions; call by value and reference, arrays, structures, classes and objects, pointers and references to objects, files and streams. Weekly laboratory experiments will provide hands-on experience in topics covered in this course.		
Pre-requisite: CS101		
BSE 0306	Numerical Methods	BSE 0306
Errors analysis, roots of equations: bracketing and open methods, solutions of linear equations: gauss elimination, LU decomposition, matrix inverse, gauss-Seidel, curve representation and fitting, numerical differentiation and integration, solutions of differential equations: runge-kutta method, boundary-value and eigen-value problems.		
Prerequisite: 30202102		
BSE0203	Technical Writing & Professional Ethics	3(3-0)
This course deals with the definition of technical writing, its standards and how they differ from other types of writing. The basics of writing official reports, laboratory reports, projects and scientific papers. The common mistakes in writing and the process of writing citations and references. The concept of professional work and the definition of professional ethics and the acceptable and unacceptable professional practices. The sources of professional ethics and reasons for non-compliance with professional ethics. Identifying different forms of professions and explaining the importance of their relationship to ethics, standards of		



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ethical behavior in science. Professional ethics in Jordanian laws and regulations.
Prerequisite: AEL102

BSE 0202	Statistics and Probabilities for Engineers	3(3-0)
Descriptive mathematical and analytical statistics, probability, discrete and continuous random variables, probability density & distribution functions, statistics of random variables, random process, ergodicity & stationarity, autocorrelation function, power spectral density, estimating the autocorrelation function, power spectral density for raw data, input–output relation of linear systems and statistical hypothesis testing. Prerequisite: 30202102		

ELE 0211	Electrical Circuits (1)	3(3-0)
Units; Definitions: charge, current, voltage, power, energy, components of electrical circuits (independent and dependent sources, resistors, capacitors, inductors), Ohm's law, Kirchhoff's voltage and current laws, series, parallel, delta and star connections of the passive elements in electrical circuits, nodal and mesh analysis of electrical circuits, Thevenin and Norton Theorems, source transformation theorem, RL, RC and RLC circuits without source and with unit step forcing source. Prerequisite: 30201102		

ELE 0212	Electrical Circuits (2)	3(3-0)
Introduction to AC waveforms, AC RL, RC and RLC circuits, phasor diagram, impedance, resonant circuits, single phase and three phase circuits, magnetically coupled circuits and transformers, two-port networks, low pass, band pass and high pass filters. Prerequisite: ELE 0211		

ELE 0214	Electrical Circuits Lab	1(0-3)
DC circuits, Ohm's law, Kirchhoff's voltage and current laws, network theorems; transient analysis of RL, RC, and RLC circuits, impedance concept, power and P.F, series and parallel resonance, three phase circuits, magnetically coupled circuits, filters. Prerequisite: ELE0212*		

ELE 0213	Digital Logic Design	3(3-0)
Number Systems and digital waveforms. Basic gates and logic functions. Boolean algebra, Boolean expressions. Logic minimization techniques. VHDL basics. Design simulation and synthesis tools for programmable logic devices. Combination logic building blocks including decoders, encoders, multiplexers, demultiplexers and magnitude comparators. VHDL for combinational circuits. Digital arithmetic, adders and subtractors. VHDL for arithmetic circuits. Basics of sequential circuits. Basic latches and flip-flops. Timing parameters and diagrams. Counter, shift registers, basic PLDs, CPLDs and FPGAs architectures. VHDL for binary counters and shift registers. State machines. System Design with state machines using VHDL. Memory devices and systems including RAM, ROM, FIFO, LIFO and dynamic RAM. Prerequisite: BSE 0201		

ELE 0216	Electronics (1)	3(3-0)
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Semiconductor diode, diode applications, BJT transistor, biasing circuits for BJT transistor, FET transistor, biasing circuits for FET transistor, transistor circuits models, small signal amplifiers. Prerequisite: ELE 0211		
ELE 0216	Electronics Lab (1)	1(0-3)
Diode characteristics, rectification, regulation, limiting and clamping, BJT transistor characteristics and applications, FET transistor characteristics and applications. Prerequisite: ELE 0216		
ELE 0321	Signals and Systems	3(3-0)
Representation and classification of signals and systems, continuous-time signals and systems, Fourier series representation, Fourier transform and its applications, Laplace transform, analog filters: LPF, BPF and HPF, sampling theorem, discrete-time signals and systems, introduction to Z-transform. Prerequisite: ELE 0211		
ELE 0322	Communications and Data Transmission	3(3-0)
Analog and Digital signals, Analogue Modulation Techniques, Principles of Data Communications, Pulse Modulation Techniques, Error detection and correction, data compression, Line Coding Techniques, Frequency Division Multiplexing and Time Division Multiplexing. Prerequisite: ELE 0321+ ELE 0213+ ELE 0205		
ELE 0334	Control Systems	3(3-0)
Introduction to Control Systems, Mathematical Models of Systems, State Variable Models, Feedback Control System Characteristics, The Performance of Feedback Control Systems, The Stability of Linear Feedback Systems, The Root Locus Method, Frequency Response Methods, Stability in the Frequency Domain, The Design of Feedback Control Systems, The Design of State Variable Feedback Systems, Robust Control Systems. Prerequisite: ELE 0321		
ELE 0431	Control Systems Lab	1(0-3)
Time Response of first and Second order system, Study of characteristics, Transfer function of DC and AC motors, Characteristics of AC servo motor, Effect of feedback on DC servo motor, Effect of P, PD, PI, PID controller on a second order systems, State space model for classical transfer function using MATLAB – Verification, system identification, Lag and lead compensation – Magnitude and phase plot, verification of Routh Horvitz criteria, Root locus plotting. Prerequisite: ELE 0334		
ELE 0335	Electrical Machines (1)	3(3-0)
Magnetic circuits; single-phase transformers: types; construction; ideal and practical transformers; equivalent circuit; testing; voltage regulation and efficiency; three-phase transformers: construction; connections and groups; in-rush currents and harmonics; preventive maintenance and testing; direct current machines: construction and classification; elementary DC machine; excitation; windings; EMF; torques and power relations; armature		

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reaction and commutation; DC generators: performance characteristics and applications; DC motors: performance characteristics; starting; speed control and applications preventive maintenance.

Prerequisite: ELE 0212

ELE 0228	Microprocessors Systems	3(3-0)
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Introduction to microprocessors and microcomputers. Microprocessors' evolution, architecture, programming model, buses and control signals. Introduction to Real-mode and protected-mode memory addressing. Introduction to Assembly programming (one of the latest 16-bit or 32-bit microprocessors can be chosen, e.g., Intel, Zilog, Motorola). Data movement instructions (different addressing modes), Arithmetic instructions: addition, subtraction, comparison, multiplication and division. Logical, shifts and rotate instructions. Stack, load-effective address, software interrupts and calling subroutine and macro. Jump instructions. Counters and time delays. String instructions. String comparisons. Code conversion. Program and machine control instructions. Direct Memory Access .Program development. Introduction to memory and I/O interface.

Prerequisite: ELE 0213

ELE 0328	Microprocessors Systems Lab	1(0-3)
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Writing, implementing and debugging assembly programs on Intel x-86 microprocessors. The lab also provides the facility to interface the microprocessor with different circuits such as A/D converters, stepper motors, multi-digit displays, sensors etc.

Prerequisite: ELE 0228

ELE 0205	Linear Algebra	3(3-0)
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Simultaneous linear equation systems and matrices. Gaussian elimination, orthogonal projection, Determinants, vector and matrix spaces, Inner product spaces, linear transformation. Eigenvalues and eigenvectors. Diagonalization and quadratic forms. Singular value decomposition. Modeling and applications in electrical engineering.

Prerequisite: 30202102

ELE 0541	Graduation Project (1)	1(0-1)
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Project under the supervision of one of an academic staff in the department, on an assigned specification topic in the related specialization. This is the first part of the project; it will normally involve literature review, theoretical work and some laboratory or fieldwork.

Prerequisite: pass 120 Cr.

Hrs.

ELE 0542	Graduation Project (2)	3(0-3)
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Project 2 is the second part of the project and will normally involve design, analysis and conclusions of the study and the submission of a final report and discussion by a committee in the department.

Prerequisite: ELE 0541

ELE 0442	Field Training	3(0-3)
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Training for 8 weeks in the field of the related specification in an approved public or private sector.

Prerequisite: pass 115 Cr. Hrs.

ELE4326	Analog Communications	3(3-0)
Signal analysis: equivalent low-pass and band-pass models, power spectral density, amplitude modulation and demodulation: large carrier and suppressed carrier, single side band modulation, vestigial side band modulation, coherent and non-coherent detection, angle modulation, frequency modulation (FM) and demodulation, wideband and narrowband FM, transmission bandwidth, generation and demodulation of FM signal, noise representation and analysis: SNR analysis of AM and FM.		
Prerequisite: ELE0321 + 0202		
ELE4423	Analog Communications Lab	1(0-3)
Analog filters (LPF, BPF and HPF), amplitude modulation (AM), single-sideband (SSB) modulation, AM receiver with automatic gain control, frequency modulation (FM), FM demodulator using phase-locked loop, FM demodulator using frequency discriminator.		
Prerequisite: ELE4326		
ELE 5364	Computer Architecture and Organization Lab	1(0-3)
A set of experiments for describing and testing a range of combinational and sequential designs using hardware description language (VHDL or Verilog) and implementing them on FPGA. More advanced experiments to design, test and implement, possibly using CAD tools, parts of a computer including ALU, register, memory, and control circuit. A simple computer design project can be requested preferably showing both synchronous/asynchronous modules (consumed power, silicon area and critical delay may be measured).		
Pre. Request: ELE 5361		

ELE 5251	Object Oriented Programming	3(2-3)
To learn the fundamental concepts and techniques behind object-oriented programming in C++. Review of control structures, data types and functions. Data Abstraction ADT. Encapsulation and information hiding. Classes, attributes and methods (operations). Objects, instantiation, and constructors. Software reuse and reengineering. Inheritance. Overloading. Polymorphism. Templates. In addition, graphical user interface will also be discussed.		
Request: BSE 0201		
ELE 5252	Data Structure and Algorithms	3(3-0)
Data types: records, files, and sets. Dynamic data structure. Single, double, and circular linked lists and queues. Stacks and binary trees. Shell sort, quick sort, binary search, and hashing. Data compression. Definitions of algorithms. Design & analysis Algorithms: Divide and conquer, Greedy algorithm. Dynamics programming. Backtracking. Branch and		



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bound technique. NP-hard and NP-complete problems. Asymptotic notations. Performance measurement. Sorting and searching: algorithms and lower bound Abstract data types and classes. Data structures: stacks, queues, lists, trees, heaps, and search tree, tries, a hashing. Graphs: representation, depth-first-search, and breadth-first-search.

Pre. Request: ELE 5251

ELE 5254	Data Structure and Algorithms Lab	1(0-3)
In this course, the student is practically trained in building software that uses data structures that are covered in the course of Data Structure and Algorithms (ELE 5252). The student is expected to acquire individual and teamwork skills in preparing this type of software.		
Pre- Request: ELE 5252		
ELE 5362	Operating systems	3(3-0)
This course enables students to understand and implement operating systems functions in managing computer systems component. It includes the following major topics: Introduction to Hardware and Software Concepts; Process and CPU Scheduling, Threads, Synchronous and Concurrent Execution, Deadlock and Indefinite Postponement; Memory Management: Physical and Virtual Memory; Management of External Storage and I/O Devices: Files Management; Performance and Optimization; Security and Protection; and Distributed Systems.		
Pre. Request: ELE 5252		
For Communication and Software Engineering [ELE 3272, Pre-req.]		
ELE 5354	Data Base Systems	3(3-0)
Basic concepts of databases. DBMS components. Transaction managements. Data modeling. Entity relationships diagrams. Relational databases. Database integrity constraints. Relational Algebra. Dependencies, schema designs normalization and redundancy elimination. By the end of the course, students are expected to be familiar with many of the principles and concepts related to databases and how these are applied in real database systems by presenting small individual/group projects.		
Pre. Request: ELE 5252		
For Communication and Software Engineering [ELE 3272, Pre-req.]		
ELE 5455	Data Base Systems Lab	1(0-3)
Experiments in designing databases using the DBMS system, such as Oracle/SQL, The students are expected to implement individual projects to refine their database development skills using the latest tools, programs and concepts covered in ELE 5354 Course.		
Pre. Request: ELE 5354		

ELE 5453	Artificial Intelligence and Machine Learning	3(3-0)
Fundamentals of machine learning and artificial intelligence. Concept of learning. Evaluating hypotheses. Supervised learning, unsupervised learning, regression and reinforcement learning. Bayesian learning. Ensemble Methods such as Genetic Algorithm, Decision Tree, Naïve Bayes, k-Nearest Neighbors, Back Propagation neural networks and		



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their applications in computer engineering.		
Pre. Request: ELE 5251+BSE 0202		
ELE 5454	Artificial Intelligence and Machine Learning Lab	1(0-3)
Introduces representations, techniques, and architectures used to build applied systems and to account for intelligence from a computational point of view. Applications of problem solving using various search techniques. Decision support system and its applications. Applications of identification trees, neural nets (Shallow and deep), genetic algorithms, and other learning paradigms. Speculations on the contributions of human vision and language systems to human intelligence. The students are expected to implement individual projects to refine their AI development skills using the latest tools, programs and concepts covered in ELE 5453 Course.		
Pre. Request: ELE 5453		
ELE 6461	Fundamentals of Computer Networks	3(3-0)
Introduction to the fundamental principles underlying telecommunication and computer networks. The course introduces the concepts of network architecture, protocols, layers, and the TCP/IP and OSI reference models. Covers topics in the application layer, transport, network, data link, and physical layers of the protocol stack with concentration on the link layers. Data link layer services: Error detection and correction, multiple access Control. Principles of Wireless Networks, Principles of Network Security.		
[Pre-req. ELE 0322]		
For Communication and software engineering Pre. Request: ELE 4461 (synchronous)		
ELE 6463	Internet of Things	3(3-0)
Introduction to Internet of Things, Definitions and Characteristics of IoT, Physical Design of IoT, Things in IoT, IoT Protocols, Logical Design of IoT, IoT Functional Blocks, To introduce students to the fundamentals of Internet of Things (IoT) and embedded computing. This course covers IoT applications, Wireless protocols, Wearable sensors, Home environment sensors, Behavior detection sensors, Data fusion, processing and analysis, Data communications, Architectural design issues of IoT layers, Security and privacy issues in IoT.		
[Pre-req. ELE 6466]		
ELE 6464	Computer Networks Lab	1(0-3)
The Computer Networks Lab consists of a set of experiments: setting up the PC and configuring the NIC, establishing a LAN, Router and network tools, router configuration and router protocols. Securing networks using routers. Configuring switches. Network address conversion, Introduction to wireless network s and configuration.		
[Pre-req. ELE 6461]		
For Communication and software engineering Pre. Request: ELE 6461 (synchronous)		
ELE 6468	Network Programming	3(2-3)
Overview of network programming and OSI reference model. Data Links and Transport Layers, Ethernet, TCP/IP protocol suite. Python Scripting, strings, lists, tuples, sets,		



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dictionary, arrays, loops function and classes definition, exceptions, inheritance, and libraries overview. Files, TCP/IP and UDP sockets programming Client/Server, threaded servers programming, multicast. Mail and handling packages, encoders, iterators, headers, SMTP, and ftp servers etc. Python CGI module, XHTML, Flask, request, response objects, SQL, and web forms handling, cookies, ecommerce.

[Pre-req. ELE 6466]

ELE 6466	Networks Protocols	3(3-0)
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Consolidate knowledge learned in ELE 647 through hands-on measurement and implementation of network protocols (link layer, IP layer, transport layer) and further experiment with state-of-the-art network architectures and applications. The course lectures will cover the following topics: network programming over TCP/UDP sockets; application-layer protocols (DNS, HTTP, P2P); multimedia protocols (video streaming, VoIP, video telephony, virtual reality); data center networking and cloud computing; software-defined networking; wireless and mobile networks architecture and core protocols (LTE, WiFi, 5G, IoT); Security in computer networks.

[Pre-req. ELE

6461]

ELE 6465	Wireless Networks	3(3-0)
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The primary objective of this course is to learn the fundamental principles underlying wireless communication networks and systems. The topics include, wireless communication fundamentals, wireless communication techniques and technologies, Wireless Personal Area Networks (WPAN), Wireless Local Area Networks (WLAN) and Wireless Mobile Networks (WMN). Wide Area Networks including cellular networks and cellular data networks.

[Pre-req. ELE

6466]

ELE 6472	Cyber Security Principles	3(3-0)
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The course introduces the real-world of cybersecurity challenges that organizations face. The challenges will be examined both how systems are exploited by attackers, and how to secure systems or respond to threats from the defender's perspectives, attack and defense strategies for computing resources. The security principles of computer and networks systems. Discusses various attack techniques and how to defend against them. Computer attacks and defenses, malicious attacks. Operating system holes, web security, e-mail, botnet, malware, social engineering attacks, privacy, and digital rights management. Authentication, authorization, multi-level security. The course will also introduce cyber security management concepts, including security operations, risk management, security engineering and security architecture, as well as provide guidance on different career paths specializing in cybersecurity.

[Pre-req. ELE 6461]

ELE 6572	Encryption and Network Security Systems	3(3-0)
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Overview of network architecture and protocols. Network specific threats and attack types. Lower layer security, physical layer security, network layer security, transport layer security;



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application layer security, e-mail security, remote access security; common network security devices; security for wireless network. Classical cryptography, substitution ciphers (Shift cipher, affine cipher, Vigenere cipher, Hill cipher), permutation (transposition) cipher, symmetric cryptography, stream ciphers (RC4, A5/1), block ciphers (DES, 3DES, Randel) and their modes of operation. Asymmetric cryptography, Diffie-Hellman key exchange, certificates, basics of public key infrastructure (PKI).

[Pre-req. ELE 6472]

For Communication and software engineering Pre. Request: ELE 6461

ELE 6574	Networks Systems Security Lab	1(0-3)
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The Networks Systems Security Lab consists of a Set of Experiments to give the Student the Practical Experience on Modern Network Security Threats, Securing Network Devices, Authentication, Authorization and Accounting, Implementing Firewall Technologies, Implementing Intrusion Prevention, Securing the Local Area Network, Cryptography, Implementing Virtual Private Networks, Managing a Secure Network.

[Pre-req. ELE 6472]

ELE 6576	Digital Forensics Systems Investigation Lab	1(0-3)
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This laboratory aims to enable students to acquire practical skills in the field of hacking techniques. While these skills can be used for harmful purposes, the goal here is to teach students how to use the same hacking techniques for ethical and practical purposes without causing harm. This course aims to provide students with the necessary skills to understand the infrastructure and vulnerabilities that are vulnerable to malicious attack. Topics covered in the course include: Enabling students to understand the attack process in order to develop the infrastructure for a secure technology against attacks, and this course deepens students' understanding of ethical hacking methodologies and applications, their techniques and tools in order to better understand how attacks are carried out.

[Pre-req. ELE

6571]

ELE 6571	Digital Forensics Systems Investigation	3(3-0)
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Covers Digital forensics, cybercrimes, computer security and network forensics and the systematic process of acquiring, authenticating and analyzing digital evidence, forensic duplication and analysis, network surveillance, intrusion detection and prevention, incident response, and trace-back. Technical and managerial topics will be explored, providing students with both theoretical and practical hands-on experience using forensic equipment and software. The topics of E-Discovery, Data Retention, Data Disposal, Litigation, Internal Investigations, Regulatory Compliance and Incident Response will also be discussed within the context of Digital Forensics. Students will have an opportunity to work with commercial and open source forensic software programs.

[Pre-req. ELE

6574]

ELE 6565	Networks Protocols Lab	1(3-0)
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Routing and Switching builds with in-depth study of advanced routing and switching for converged voice, video, and data enterprise networks. A set of experiments to give the



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student the practical experience on the following components: wireless networks and networks security, installing wireless adapters, building adhoc wireless networks, configuring access points, configuring wireless bridges, basic wireless networks security, advanced router security, basic PIX firewall security, basic VPN configuration.

[Pre-req. ELE 6466]

ELE 6575	Special Topics in Networks Systems & Security	3(0-3)
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The objective of this course is to introduce advanced and new topics in one of the areas of computer networking. The topics can be changed from one year to another depending on the instructor's areas of specialty.

[Id. By department]

ELE 6566	Cloud Computing	3(3-0)
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This course covers theoretical models, definitions, and practical aspects related to cloud computing, including the basics of hardware visualization and its role in building data centers, self-management of data centers. It focuses on the hardware and software architecture used in cloud computing, the security aspects including the policies, technologies, and controls applied to protect data, applications, and the infrastructure of cloud computing. Fundamentals of software-defined networking (SDN). Control, data, and management plane separation. Northbound and southbound APIs. Network function virtualization (NFV), network orchestration, service chaining. SDN and NFV protocols and controllers such as OpenFlow, Open Day light, and Open Network Operating System (ONOS). Software-defined networks and how to change the way communications networks are managed, maintained, and secured.

[ELE 6461, Pre-req. 90 Cr. Hrs.]

For Network Systems and Security Engineering [ELE 6466, Pre-req.]

ELE 6570	Wireless Sensor Networks	3(3-0)
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Wireless sensor networks are pervasive computing systems consisting of smart sensors embedded in physical environments. Wireless sensor networks provide a basis for Internet of Things that challenges many classical approaches to distributed computing and networking. Embedded operating systems, wireless network protocols, and approaches to power management, real-time, and middleware services fundamentally change when confronted with this new environment. Wireless sensor network is an exciting research area with many promising applications, such as health monitoring, smart home, smart energy, and industrial process automation. This course will study cutting-edge research papers that deal with various aspects of wireless sensor networks. Students will perform hands-on, system projects using smart phones or motes (tiny devices consisting of sensors, radios, and microprocessors).

[Pre-req. 90 Cr. Hrs.]

ELE 6578	Ethical Hacking	3(3-0)
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Ethical Hacking & Countermeasures. This course immerses the students into a hands-on environment where they will be shown how to conduct ethical hacking. They will be exposed



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to an entirely different way of achieving optimal information security posture in their organization; by hacking it! They will scan, test, hack and secure their own systems.

[Pre-req. 90 Cr.

Hrs.]

ELE 6569	Network performance modeling and simulation	3(3-0)
Introduction to simulation concepts, discrete event simulation, random number generation, input modeling; Includes computer and network design and analysis topics covering mathematical modeling, simulation techniques for performance evaluation, applied probability, stochastic processes, elementary queuing theory, discrete-event simulation, and simulation of data analysis. The techniques of the course can be used to analyze and compare any type of systems including algorithms, protocols, network, or database systems. Students do a project involving application of these techniques to a problem of their interest. Well-known network simulation packages to analyze computer networks, protocols, and data traffic. Using and applying one of the simulation tools and software.		
[Pre-req. 90 Cr. Hrs.]		
ELE 6457	Introduction to Linux	3(3-0)
An introduction to Linux, it focuses on using Linux from the command line. Basic Linux concepts, such as processes, files and folders, piping, I / O, redirection, shells, casings etc., the X-window system or the Unix graphical interface system, and one of the window managers used in Linux. Basic Linux commands and software, and standard software development tools, such as Emacs, compilers, error tracers, build tools, and automate system tasks and management using sugar bits scripts.		
[Pre-req. 90 Cr. Hrs.]		

(*)co-requisite