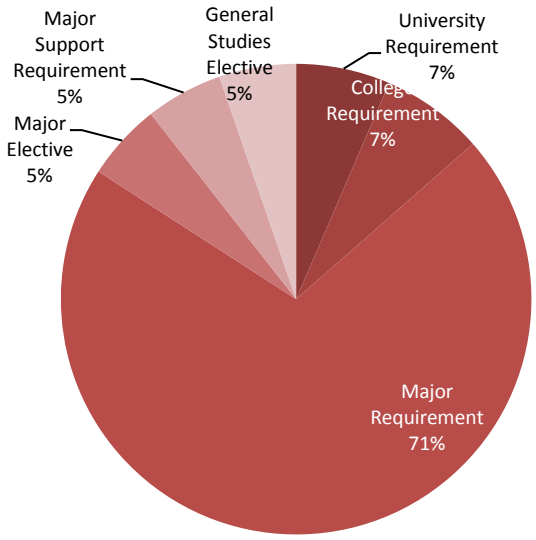
B.Sc. in Electronic Engineering 2014

Program components

Course Type	CRD
University Requirement (UR)	11
College Requirement (CR)	31
Major Requirement (MR)	70
Major Elective (ME)[1]	9
Major Support Requirement (MSR)	14
Minor Requirements (Minor)	------
MR- Industrial Training	2
Total Credit (CRD)	137



[1] Student must choose two elective courses from Major Elective Courses lists.

Teaching Language: English

Detailed Study Plan

Year 1 - Semester 1

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
MATHS 101	Calculus I	3	0	3	CR	------	No
CHEMY 101	General Chemistry I	3	3	4	CR	------	No
PHYCS 101	General Physics I	3	3	4	MSR	------	No
CSC 103	Computer Programming for Scientists and Engineers	3	2	3	CR	------	No
ENGL 101	Communication Skills I	3	0	3	CR	------	No

Year 1 - Semester 2

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
MATHS 102	Calculus II	3	0	3	CR	MATHS101	No
PHYCS 102	General Physics II	3	3	4	MSR	PHYCS101	No
ENGL 102	Composition and Reading II	3	0	3	CR	ENGL101	No
STAT 273	Probability and Statistics	3	0	3	CR	MATHS 101	No
HRLC 107	Human Rights	2	0	2	UR	-------	No
EENG 100	Circuit Theory I	3	1	**3**	MR	MATHS 101	Yes

Year 2 - Semester 3

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
MATHS 205	Differential Equations	3	0	3	CR	MATHS 102	No
MENG 230	Thermal Sciences	3	1	3	MSR	-------	No
EENG 204	Computer Applications in Electrical Eng.	0	6	2	MR	EENG 100 & CSC 103	Yes
EENG 261	Electronic Devices and Circuits	3	1	3	MR	EENG 100 & PHYCS 102	Yes
EENG 200	Circuit Theory II	3	1	3	MR	EENG 100 & MATHS 101	Yes
EENG 242	Technical Report Writing and Presentation	1	1	1	MR	ENGL 102	Yes

Year 2 - Semester 4

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
EENG 290	Junior Project	0	3	1	MR	EENG 242	Yes
MATHS 203	Calculus III	3	0	3	CR	MATHS 102	No
EENG 271	Signals and Systems	3	1	3	MR	EENG 200 & MATHS 205	Yes
EENG 262	Analog Electronics	3	1	3	MR	EENG 261	Yes
EENG 205	Numerical Analysis	2	3	3	MR	MATHS 205	Yes
EENG 251	Digital Systems I	3	1	**3**	MR	-------	Yes

Year 3 - Semester 5

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
EENG 302	Electronic Instrumentation	3	1	3	MR	EENG 261 & EENG 200	Yes
EENG 352	Digital Systems II	3	1	3	MR	EENG 251	Yes
EENG 343	Electrical Machines	3	1	3	MR	EENG 200	Yes
EENG 371	Electromagnetics	3	1	3	MR	MATHS 203 & PHYCS 102	Yes
EENG 372	Communication Systems I	3	1	3	MR	EENG 271	Yes
MATHS 342	Linear Algebra and Complex Analysis Variables	3	0	3	MSR	MATHS 102	No

Year 3 - Semester 6

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
EENG 364	Digital Integrated Circuits	3	1	3	MR	EENG 261	Yes
EENG 373	Communication Systems II	3	1	3	MR	EENG 372 & STAT 273	Yes
EENG 353	Microprocessors	3	1	3	MR	EENG 352 & CSC 103	Yes
EENG 381	Control Systems	3	1	3	MR	EENG 271	Yes
MENG 300	Engineering Economics	3	1	3	CR	Completion of 60 Credits	No
HIST 122	Modern History of Bahrain and Citizenship	3	0	3	UR	------	No

Training Requirement

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
EENG 390	Industrial Training	**0**	6	**2**	**MR-Training**	Completion of 85 credits	Yes

Year 4 - Semester 7

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
EENG 462	Advanced Electronics	3	1	3	MR	EENG 262	Yes
EENG 417	Power Systems	3	1	3	MR	EENG 343	Yes
EENG 490	Senior Design Project	0	9	3	MR	Completion of 85 Credits & EENG 290	Yes
EENG 4xx	Elective I	3	1	3	ME	As per ME list	Yes
EENG 400	Engineering Ethics	2	0	2	MR	Completion of 85 Credits	Yes
ISLM 101	Islamic Culture	3	0	3	UR	-------	No

Year 4 - Semester 8

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
EENG 479	Digital Signal Processing	3	1	3	MR	EENG 271	Yes
EENG 433	Power Electronics	3	1	3	MR	EENG 262	Yes
EENG 4xx	Elective II	3	1	3	ME	As per ME list	Yes
EENG 4xx	Elective III	3	1	3	ME	As per ME list	Yes
EENG 491	Electrical Engineering Seminar	0	2	1	MR	Completion of 85 Credits	Yes
ARAB 110	Arabic Language Skills	3	0	3	UR	-----	No

Major Elective Coures[1]

Three electives courses (9 credits) will be chosen from the following major options.

Major in Digital Systems

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
EENG 451	Computer Organization	3	1	3	ME	EENG 353	Yes
EENG 453	Multimedia Systems	3	1	3	ME	EENG 373 & EENG 353	Yes
EENG 454	Advanced Logic Design	3	1	3	ME	EENG 353	Yes
EENG 456	Computer Interfacing	3	1	3	ME	EENG 353	Yes
EENG 457	Computer Networks	3	1	3	ME	EENG 373 & EENG 353	Yes
EENG 458	Embedded System Design	3	1	3	ME	EENG 353	Yes
EENG 464	VLSI Circuits	3	1	3	ME	EENG 364	Yes
EENG 486	Intelligent Control Systems	3	1	3	ME	EENG 381	Yes

Major in Applied Electronics

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
EENG 451	Computer Organization	3	1	3	ME	EENG 353	Yes
EENG 461	RF Communication Circuits	3	1	3	ME	EENG 364 & EENG 372	Yes
EENG 463	Integrated Circuits and Applications	3	1	3	ME	EENG 262	Yes

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
EENG 464	VLSI Circuits	3	1	3	ME	EENG 364	Yes
EENG 466	Communication Circuits	3	1	3	ME	EENG 262 & EENG 373	Yes
EENG 485	Nonlinear Control Systems	3	1	3	ME	EENG 205 & EENG 381	Yes
EENG 484	Biomedical Instrumentation	3	1	3	ME	EENG 364	Yes
EENG 486	Intelligent Control Systems	3	1	3	ME	EENG 381	Yes

Major in Communication Engineering Course

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
EENG 453	Multimedia Systems	3	1	3	ME	EENG 373 & EENG 353	Yes
EENG 470	Satellite Communications	3	1	3	ME	EENG 371 & EENG 373	Yes
EENG 472	Optical Fibers Communications	3	1	3	ME	EENG 371	Yes
EENG 473	Mobile Communications	3	1	3	ME	EENG 373 & EENG 371	Yes
EENG 474	Communication Networks	3	1	3	ME	EENG 373	Yes
EENG 476	Microwave Engineering	3	1	3	ME	EENG 371	Yes
EENG 477	Antenna and Propagation	3	1	3	ME	EENG 371	Yes

Course Description

Course Code: EENG 100 **Course Title:** Circuit Theory I
Circuit elements, Lumped circuits Kirchhoff's laws. Network theorems. Sinusoidal steady-state analysis, single phase and 3-phase balanced and unbalanced networks. Coupled networks, series and parallel magnetic circuits.

Course Code: EENG 200 **Course Title:** Circuit Theory II
Natural and forced response of first and second order RLC networks. Laplace transform and application phase concept. Analysis of linear time-invariant circuits. Convolution network graphs. Tellegen's theorem. More on time domain solution of networks by Laplace transformation. Frequency response, bandwidth and quality factor. Transfer function. State equation and Two-port networks. Computer aided analysis of circuits.

Course Code: EENG 204 **Course Title:** Computer Applications in Electrical Engineering
Laplace Transforms. Software packages used in electrical and electronics engineering. Programming with MATLAB, Simulink, MATCAD, PSPICE, Circuit Maker, Electronics Workbench and LABWIEW. Intensive hands on applications of these packages on Electrical and Electronics Engineering topics in PC Laboratories.

Course Code: EENG 205 **Course Title:** Numerical Analysis

Roots of nonlinear equations. Roots of simultaneous equations: Matrix Inversion, Gauss, Gauss-Jordan, Gauss-Sidel, Cholesky methods, Solution of nonlinear simultaneous equations. Numerical solution of ordinary differential equations, Numerical differentiation and integration. Interpolation and curve fitting methods. Introduction to Finite Difference and Finite Element methods.

Course Code: EENG 242 **Course Title:** Technical Report Writing and Presentation

Technical Report Writing prepares students to design and compose effective technical documents, with particular emphasis on technical reports and oral presentations. The lecture hour is dedicated to theories, techniques and presentations. The tutorial hour is assigned to discuss the written reports feedbacks.

Course Code: EENG 251 **Course Title:** Digital Systems I

Number systems; Basic logic gates; Boolean algebra; Simplification of logic functions: Karnaugh maps, Quine-McCluskey method, NAND and NOR gates networks; Multiple output networks; MSI combinational logic circuits: Multiplexers, Decoders, Adders, Comparators; Tri-State logic; combinational logic circuits design with programmable logic devices: Memories, PLA, PAL; Flip-Flops; Design and analysis of counters and registers.

Course Code: EENG 261 **Course Title:** Electronic Devices and Circuits

Semiconductor fundamentals: carrier transport and recombination, doped materials, physics and applications of pn junction diode, Zener diode characteristics and applications, special purpose diodes, Fundamentals of BJTs and FETs, DC analysis of transistors circuits, Transistors as a switch, Transistor as an amplifier, Small signal equivalent circuits, Biasing techniques, Basic single stage amplifiers.

Course Code: EENG 262 **Course Title:** Analog Electronics

Differential amplifiers, Multistage amplifiers: Cascade, cascade and Darlington pair configurations, Basic building blocks of op amp. Ideal op amp characteristics, positive and negative feedback applications of ideal op amp, Non-ideal op amp, Frequency response of amplifiers, Feedback concepts and topologies, Filters, Output stage and power amplifies.

Course Code: EENG 271 **Course Title:** Signals and Systems

Elementary continuous and discrete-time signals signal decomposition and convolution, sampling theory and Nyquist theorem, Laplace and Z transforms, Fourier series and integral with applications, Linear Time-Invariant (LTI) systems: Properties, impulse and frequency responses, Pole-zero description, input-output difference and differential equations, transient and steady-state time responses to elementary signals.

Course Code: EENG 302 **Course Title:** Electronic Instrumentation

Introduction to measurements and instrumentation. AC/DC indicating instruments. Measurements of R,L, and C parameters. Digital measurements techniques. Recording instruments, and image understanding. Modern data acquisition systems. Modern process instrumentation.

Course Code: EENG 343 **Course Title:** Electrical Machines

Magnetic circuits, Transformers: Construction, principles of operation, equivalent circuit, efficiency, voltage regulation, 3-phase connections. 3-phase Induction Motors: equivalent circuit, energy balance, torque and slip, starting, speed control. Synchronous Generators: operating principles, phasor diagrams, voltage regulation, active and reactive powers. DC machines: construction, methods of excitation, starting and speed control.

Course Code: EENG 352 **Course Title:** Digital Systems II

Finite State Machine: derivation of state graphs and tables, reduction of state tables, state assignment. Digital system design with: PALs, PLAs, SPLDs, registers, counters, memories, CPLDs, FPGAs. Digital System Architecture: Data path and control. Algorithmic state machines. Logic controllers for sequential arithmetic circuits. Introduction to Hardware Description Languages. VHDL Design Styles (data flow, behavioural, structural). VHDL Representation of Combinational and Sequential logic Circuits. Compile, simulate and synthesize sequential logic circuits. Use of CAD tools in Digital System Design

Course Code: EENG 353 **Course Title:** Microprocessors

Fundamentals of microprocessor: architecture, software development and interfacing. Emphasis is placed on 8-bit microprocessors systems extended to 16 and 32 bit microprocessor architecture; Assembly language programming; Memory systems; Memory mapping & decoding; Interfacing I/O devices; I/O data transfer: handshaking, interrupts, DMA; Programmable interface devices; Interfacing data converters.

Course Code: EENG 364 **Course Title:** Digital Integrated Circuits

A comprehensive view of digital integrated circuits. Digital logic family; Analysis of logic gates: TTL, ECL, MOS, CMOS. Design of static & dynamic MOS gates. Design and performance of simple gate functions. Sequential logic circuits: analysis & design Registers and clocking schemes. Memory design.

Course Code: EENG 371 **Course Title:** Electromagnetics

Vector Analysis: Vector algebra and calculus. Electrostatics: Fields, potentials and boundary conditions. Magnetostatics: Fields and boundary conditions. Maxwell's equation; Time varying fields and potentials, harmonic fields. Electromagnetic waves propagation: Plane waves and reflection. Antenna fundamentals. Radiation from linear wire antennas.

Course Code: EENG 372 **Course Title:** Communication Systems I

Overview of communication systems, random processes, mean, correlation, power spectral density, noise in amplitude modulations (DSB-SC, SSB,VSB) ,AM demodulation, frequency modulation, phase modulation, FM demodulation, noise in AM, and FM, pulse modulation (PAM, PCM) frequency division multiplexers (FDM), match filter, ISI, adaptive equalizers.

Course Code: EENG 373 **Course Title:** Communication Systems II

Signal-Space analysis: geometric representation, conversion of continuous AWGN to Vector channel, Maximum likelihood decoding, correlation receiver, probability of error. Passband digital transmission: synchronous PSK and FSK, hybrid Amplitude/Phase modulation schemes, comparison of digital modulation schemes. Information theory: average information and channel capacity, source coding. Error control: basic block codes and CRC, convolution codes encoding and decoding .

Course Code: EENG 381 **Course Title:** Control Systems

Introduction to control systems. Representation of physical control system elements. Analogies, Transfer functions, Signal flow graphs. State space analysis. Sensitivity, static accuracy and transient response. Stability of control systems : Routh criterion, Root locus, Frequency response methods, Nyquist stability criterion. Compensation techniques. Introduction to digital control and the Z transform. Discrete time control system.

Course Code: EENG 390 **Course Title:** Industrial Training

In this industrial training course all students must participate in an approved training program in the relevant industry, developing a multidisciplinary and teamwork experience. At the completion of 300 hours of supervised training each student must submit a formal report and oral presentation.

Course Code: EENG 400 **Course Title:** Engineering Ethics

Scope of engineering ethics. Moral reasoning and resolving ethical dilemmas. Codes of ethics. Engineering as experimentation, Engineers as responsible experimenters. Commitment to safety: Safety and risk, Teamwork: Definition, types of teams and groups. Confidentiality and conflict interest. Conflict management. Honesty, Environmental ethics, Global issues, Engineering and technological progress: Optimism, pessimism and realism, shared responsibility, moral leadership.

Course Code: EENG 417 **Course Title:** Power Systems

Power generation, types of prime movers. Parallel operation of synchronous machines. Active and reactive power control in synchronous generators. Transmission line parameters, short, medium and long line representation; voltage drop calculations; reactive power compensation. Cables for interior wiring and power transmission. Fuses, Contactors and Circuit breakers. Tariffs.

Course Code: EENG 433 **Course Title:** Power Electronics

Characteristics and brief physics of Power Semiconductor Devices: Power Diodes, Power MOSFET, IGBT, SCR, GTO, Triac, UJT and PUT. Single and 3-phase controlled AC-DC converters, AC voltage controllers. Choppers. Buck, Boost, Buck-Boost and Cuk regulators, Flyback and Forward converters, Feedback control of converters. DC/AC inverters. Resonant regulators. Gate/Base drives circuit. Filter design. DC and AC Power Supplies. UPS circuits. Device protection.

Course Code: EENG 462 **Course Title:** Advanced Electronics

Feedback topologies and analysis, Feedback and stability, Analog integrated circuits, Filters, Sensitivity, Switched capacitor filters, Oscillators, Multivibrators, Integrated circuit timers, Wave shaping circuit.

Course Code: EENG 479 **Course Title:** Digital Signal Processing

Review of discrete time signals and systems, Z-transform, sampling and aliasing, discrete time convolution and correlation, DFT and FFT, relating frequency response of analogue and digital filters, analysis, design and implementation of FIR and IIR filters. Noise in digital filters. Applications and typical real time implementation of digital filters.

Course Code: EENG 490 **Course Title:** Senior Design Project

Senior students are required to carry out a design project, using knowledge and skills obtained in prior courses wherein they incorporate engineering standards and multiple realistic constraints such as economic, ethical, social, political, environmental, health and safety, manufacturability and sustainability. The students are expected to work in teams and are required to submit a written report and conduct an oral presentation.

Course Code: EENG 491 **Course Title:** Electrical Engineering Seminar

The course is intended to enhance students' capability to use available resources, like library and internet, to prepare seminars on selected topics in order to develop skills and apprise them of lifelong learning and contemporary issues. The students will work in teams on the assigned seminar topics and give oral presentations. The invited guest speakers will give talks on topics related to engineering profession. The students' attendance is compulsory and they will be required to submit summary of the lecture giving important salient features, which will be evaluated.

Course Code: EENG 451 **Course Title:** Computer Organization

Introduction, digital hardware, data representation, computer structure. Register transfer. Microprocessor types. (RISC and CISC); timing and control, memory reference, I/O and interrupt. System's software – machine & Assembly. CPU, ALU design. Control organizations: Hardware & Micro-programmed. I/O & Memory Units. Introduction to parallel processing.

Course Code: EENG 453 **Course Title:** Multimedia Systems

Architecture, hardware, software and standards of multimedia information systems and multimedia networks. Multimedia networks, transport protocols, multicast, and resource management. Audio compression standards, still images and video compression standards (JPEG, MPEG-1 and MPEG-2). Video conferencing standards, video servers, and digital libraries. Multimedia real-time processing, multimedia enhanced computer systems.

Course Code: EENG 454 **Course Title:** Advanced Logic Design

Advance topics in digital logic design, methodologies, and applications. Design of complex, high-speed digital circuits and systems. The use of modern EDA tools in the design, simulation, synthesis and implementation is explored. Application of a hardware description language such as Verilog or VHDL to model digital systems at Behaviour and RTL level is studied. Field programmable gate arrays (FPGA) are used in the laboratory exercises as a vehicle to understand complete design-flow of an integrated circuit. Advanced methods of logic minimization and state-machine design are discussed. Design and implementation of digital system building blocks such as arithmetic circuits, datapaths, microprocessors, I/O modules, UARTs, frequency generators, memories etc. is included.

Course Code: EENG 456 **Course Title:** Computer Interfacing

Personal computer (PC) architecture. Bus standards, Interrupts, direct memory access, and I/O capabilities. Designing interface ports, serial and parallel I/O ports, UART, A/D and D/A converters. Design, implementation, and debugging of computer interfacing circuits. Computer peripherals, device drivers, and development tools. Cases studies such as data acquisition systems, computer controlled motors, and interfacing to robotics.

Course Code: EENG 457 **Course Title:** Computer Networks

Computer network architecture, OSI seven-layer reference model, emphasis on the data link, network, and transport layers. Transmission media, switching methods, topologies, multiplexing, routing, and congestion control. Elementary queuing theory and network protocols. Emerging protocols. Error recovery and reliability. Applications including electronic mail, virtual terminals, and distributed operating systems.

Course Code: EENG 458 **Course Title:** Embedded System Design

Introduction to embedded-system applications and platforms. Architecture of embedded processor/microcontroller. Embedded system memory architecture, High level programming and real time operating systems for embedded systems. Software and hardware tradeoffs. Input/output interfacing techniques for devices such as sensors, actuators, Serial communication, digital and analog I/O, timers and interrupts. Wired and wireless and internet embedded networking. Case studies of real-world embedded systems

Course Code: EENG 461 **Course Title:** RF Communication Circuits

Parallel and series resonant circuits, Coupling tuned circuits, Double tuned circuits, Modulators (AM, FM and PM), RF power Amplifiers, Impedance matching network, Super heterodining, Small signal RF amplifiers, IF amplifiers, Modulators and detectors, Phase-locked loop: Principles and applications, Basic and VHD TV.

Course Code: EENG 463 **Course Title:** Integrated Circuits and Applications

Timer IC applications: Monostable, astable operation, Voltage-to-frequency conversion, Voltage-to-period conversion, Frequency-to-voltage conversion OTA's and CFB op amps, PLL: Analog multipliers, dividers, exponent and logarithmic amplifiers, Modulation and demodulation.

Course Code: EENG 464 **Course Title:** VLSI Circuits

Historical perspective of VLSI design, MOS transistors: Theory of operation, device modelling, secondary effect models, Scaling properties and design trade-off, Analysis and design of MOS analog and Digital integrated Circuits, VLSI circuits using BJTs, new trends in VLSI circuit design.

Course Code: EENG 466 **Course Title:** Communication Circuits

Principles of sampling theorem, PAM, PWD and PPM circuits, Delta modulators and demodulators, PCM theorem and circuits. Compressors and expanders, A/D and D/A converters, Error detection circuits, Noise and data error, serial transmission interfacing, Modems, FSK, PSK, QFSK, QAM circuits, Spread Spectrum Systems, Cellular Systems.

Course Code: EENG 470 **Course Title:** Satellite Communications

Introduction. Orbital aspects and spacecraft's. Antenna systems for satellites. Performance and design parameters. Down and up links design. Modulation and Multiplexing techniques for satellite links. Multiple access, encoding and error correction. Influence of earth path on satcom. Earth station technology. Satellite TV network distribution. (direct broadcasting frequencies, receivers). Typical examples (INMARSAT, INTELSAT, ARABSAT, GPS).

Course Code: EENG 472 **Course Title:** Optical Fibres Communications

Ray theory (acceptance angle, numerical aperture). Optical fiber wave guides (modes of propagation, phase and group velocity) Types of optical fibre (step index, graded index, and single mode). Transmission characteristics of optical fibres, connectors. Optical fiber measurements. Optical sources (LED and Lasers). Optical detectors (avalanche photo diode and PIN diode). Optical fibre systems (analogue and digital modulations). Applications.

Course Code: EENG 473 **Course Title:** Mobile Communications

Engineering aspects of mobile systems: multi-user environment, system capacity, concepts of frequency reuses and channel allocation algorithms. Public and private mobile systems, cellular systems, high capacity analogue and digital systems, signalling and protocols issues, vehicle allocation and hand-over techniques. GSM. Mobile satellite systems. Personal communications: microcellular architecture. Implementation of mobility in network protocols. Indoor high speed data networks: radio LANs and WANs and their interconnection.

Course Code: EENG 474 **Course Title:** Communication Networks
Overview of modern communication networks (PSTN, ISDN, PDH, SDH, and broadband networks). Signalling network and switching system control. Data networks protocols; layering principles, OSI model, dynamic routing and congestion control. Applications to WANs MANs and LANs. Network performance evaluation: introduction to queuing theory. Single, multi-user, and tandem queues. Network delay analysis.

Course Code: EENG 476 **Course Title:** Microwave Engineering
Microwave impedance and matching. Microwave passive devices: Couplers, circulators, tapers, phase shifters, isolators. Microwave filters. Microwave active devices. Microwave networks. Introduction to microwave integrated circuits.

Course Code: EENG 477 **Course Title:** Antenna and Propagation
Wave propagations in different media, wave polarization and reflections, dipoles, half wave antennas, quarter wave antennas, small loop antenna parameters and characteristics. Antenna arrays. Effective area and fries equation. Dish antenna and reflectors. Hovn antenna. Radio system and equation. Electromagnetic interference and compatibility.

Course Code: EENG 484 **Course Title:** Biomedical Instrumentation
Basic transducer Principles: Electrode transducers, resistive transducers, capacitive transducers and inductive transducers. Cardiovascular system measurement: Electrocardiogram, blood flow, blood pressure, measurements in the respiratory and nervous systems. Pneumatography, Plethysmography and Electroencephalograms. Non invesive diagnostic instrumentation: Ultrasonic blood flow equipment, patient care equipment, pacemaker, defibrillator.

Course Code: EENG 485 **Course Title:** Nonlinear Control Systems
State-space analysis methods. Phase plane construction: the isocline Lienard's methods, classification of singularities. Variable structure control. Stability definitions. Lyapunov's second methods; Popov stability criterion. Describing functions. Optimal control and estate estimation. Conservative and Lagrangian systems. Kalman-Bucy algorithm and Prediction.

Course Code: EENG 486 **Course Title:** Intelligent Control Systems
Introduction: History, methods, current thrusts. Nonlinear control system. Uncertain dynamic systems. Computational intelligence, neural networks, fuzzy logic systems, genetic programming and optimization, simulating annulling, and learning control techniques. Controller synthesis and design using computational intelligence techniques. Optimization techniques and Biometric methods. Foraging: prey model from behavioural ecology, autonomous robot applications, Multi-agent system. Examples of applications in plant control, and robotics.

Course Code: MATHS 342 **Course Title:** Linear Algebra and Complex Analysis
System of linear equations, Matrices, Determinants, Vector spaces, Subspaces, Linear independence, Linear transformations, Complex numbers, Analytical functions, Cauchy Integral theorem and formula, Residues, contour integration.

Course Code: PHYCS 101 **Course Title:** General Physics I
Units and measurements; brief review of vectors; Newton’s laws of motion; projectile motion; work and energy; impulse and momentum; rotational dynamics; equilibrium of a rigid body; periodic motion.

Course Code: PHYCS 102 **Course Title:** General Physics II
Electric charges and fields; Coulomb’s and Gauss’s laws; electric potential; capacitors and dielectrics; direct current circuits; Kirchoff’s rules; magnetic field and flux; ampere’s law; induced emf; Lenz’s law; mutual and self inductance; AC circuits; RLC circuit**.**)

Course Code: MENG 230 **Course Title:** Thermal Sciences
Basic concepts of thermodynamic, properties of pure substances, phase equilibrium, properties tables. The ideal gas equation of state. The First Law of thermodynamics: heat, work applications to closed and open systems. The Second Law of Thermodynamics: the concept of entropy. Power cycles. Introduction to heat transfer, modes of heat transfer: conduction, convection and radiation. Heat exchangers.

College Requirement Courses Descriptions

Course Code: CHEMY 101 **Course Title:** General Chemistry I
Significant figures, chemical formulas and equations; mass relations, limiting reactions and theoretical yield; Physical behavior of gases; electronic structure, periodic table, covalent bonding; Lewis structures, Molecular structures, hybridization; molecular orbitals, solutions; colligative properties. Related practical work.

Course Code: CSC 103 **Course Title:** Computer Programming for Scientists and Engineers
Introduction to computers, their uses, development, components, hardware, and software. Internal representation and numbering systems. Algorithmic problem solving principles. Introduction to a modern programming language (e.g. C++). Input/Output, conditional statements, iteration, files, strings, functions and arrays. Lab assignments to practice programming.

Course Code: ENGL 101 **Course Title:** Communication Skills I
This course focuses on reading skills and strategies and language development. The reading section concentrates on high-interest contemporary topics and encourages students to increase speed and efficiency. The writing component, integrated to the reading materials, reviews grammatical structures, develops language accuracy and introduces paragraph writing. Students are required to upgrade their grammar, reading, and listening skills on the internet.

Course Code: ENGL 102 **Course Title:** Composition and Reading II
A continuation of English 101 which further develops the students' skills in reading and writing. The course exposes students to wider range of reading material aimed at developing their understanding of different styles of English.

Course Code: MATHS 101 **Course Title:** Calculus I
Algebra. Functions and graphs. Trigonometry. Conic sections. Limits and continuity. Derivatives and integrals. Applications of derivatives which include mean value theorem, extrema of functions and optimization. Definite integrals and the Fundamental Theorem of Calculus.

Course Code: MATHS 102 **Course Title:** Calculus II
Applications of definite integrals, including areas, volumes and surface areas of solids of revolution, arc length and centroids. Transcendental functions, indeterminate form and L'Hopital's Rule. Techniques of integration and improper integrals. Infinite series, power series. Maclaurin and Taylor Theorem.

Course Code: MATHS 203 **Course Title:** Calculus III
Parametric equations and polar coordinates. Vectors and surfaces. Limits, derivatives, and integrals of vector-valued functions. Partial differentiation. Multiple and line integrals and their applications. Green's and Stokes' Theorems.

Course Code: MATHS 205 **Course Title:** Differential Equations
Differential equations of first order and their solution. Separable and exact equations. Equations convertible to separable type. Higher order linear equations with constant coefficients (homogeneous and non-homogeneous). Power series method for second order linear equations. Variation of parameters. Laplace transform technique. Applications of differential equations.

Course Code: MENG 300 **Course Title:** Engineering Economics
Introduction to engineering economics. Principles of money time relationships. Present worth analysis. Annual worth analysis. Rate of return analysis. Benefit/cost analysis. Breakeven analysis and payback period. Capital rationing among independent proposals. Replacement and retention analysis. Cost estimation and indirect cost allocation. Depreciation and depletion. Inflation and deflation. Decision making under risk. Case studies. *(One tutorial hour)

Course Code: STAT 273 **Course Title:** Probability and Statistics
Descriptive statistics, Introduction to probability and probability distributions. Some of probability Densities, Sampling distributions. Central limit theorem. t and F distributions. Estimation. Tests of hypotheses. Goodness of fit tests. Regression and correlation.

University Requirements Courses Descriptions

Course Code: ARAB 110 **Course Title:** Arabic Language Skills
This course focuses on basic Arabic skills including form, function, and meaning. It also helps the student to appreciate and understand structures and approach them from a critical point of view, through various genres in literature.

Course Code: HIST 122 **Course Title:** Modern History of Bahrain and Citizenship
Spatial identity of Bahrain: Brief history of Bahrain until the 18th century; the historical roots of the formation of the national identity of Bahrain since the 18th century; the modern state and evolution of constitutional life in Bahrain; the Arabic and Islamic dimensions of the identity of Bahrain; the core values of Bahrain's society and citizenship rights (legal, political, civil and economic); duties; responsibilities and community participation; economic change and development in Bahrain; Bahrain's Gulf, Arab and international relations.

Course Code: HRLC 107 **Course Title:** Human Rights
This course deals with the principles of human rights in terms of the definition of human rights, scope, sources with a focus on the International Bill of Human Rights; The Charter of the United Nations; Universal Declaration of Human Rights; The International Covenant on Economics, Social and Culture rights; Convention against Torture and other Cruel, Inhuman or Degrading Treatment or Punishment; Mechanics and the Constitutional Protection of Rights and Public Freedoms in Kingdom of Bahrain.

Course Code: ISLM 101 **Course Title:** Islamic Culture
An introduction to the general outline and principles of Islamic culture, its general characteristics, its relationships with other cultures, general principles of Islam in beliefs, worship, legislation and ethics.