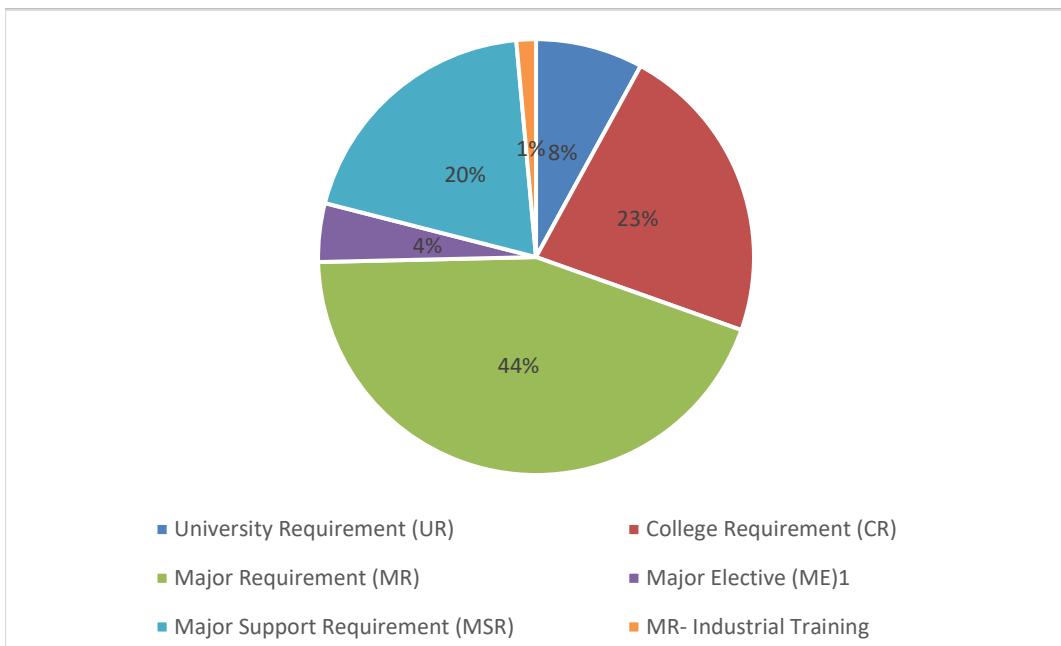


# Bachelor of Science in Process Instrumentation and Control Engineering 2014

## Program Components



<b>University Requirement (UR)</b>	<b>11</b>
<b>College Requirement (CR)</b>	<b>31</b>
<b>Major Requirement (MR)</b>	<b>61</b>
<b>Major Elective (ME)<sup>1</sup></b>	<b>6</b>
<b>Major Support Requirement (MSR)</b>	<b>27</b>
<b>Minor Requirements (Minor)</b>	-----
<b>MR- Industrial Training</b>	<b>2</b>
<b>Total Credit (CRD)</b>	<b>138</b>

<sup>1</sup> Student must choose two elective courses from Major Elective Courses list.

**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			
CHEMY 101	General Chemistry I	3	3	4	CR	-----	No

CSC 103	Computer Programming for Scientists and Engineers	3	2	3	CR	-----	No
ENGL 101	Communication Skills I	3	0	3	CR	-----	No
MATHS 101	Calculus I	3	0	3	CR	-----	No
PHYCS 101	General Physics I	3	3	4	MSR	-----	No

### Year 1 - Semester 2

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
EENG 109	Circuit Theory	3	1	3	MSR	PHYCS 101	No
ENGL 102	Composition and Reading II	3	0	3	CR	ENGL 101	No
HRLC 107	Human Rights	2	0	2	UR	-----	No
MATHS 102	Calculus II	3	0	3	CR	MATHS 101	No
PHYCS 102	General Physics II	3	3	4	MSR	PHYCS 101	No
PICENG 111	Introduction to Process Engineering	3	1*	3	MR	CHEMY 101	Yes

### Year 2 - Semester 3

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
EENG 269	Electronics	3	2	4	MSR	EENG 109	No
PICENG 242	Technical Report Writing and Presentation	1	1*	1	MR	ENGL 102	Yes
MATHS 205	Differential Equations	3	0	3	CR	MATHS 102	No
PICENG 212	Process Thermodynamics	3	1*	3	MR	PICENG 111	Yes
PICENG 213	Transport Processes I	2	1	2	MR	PICENG 111	Yes
PICENG 215	Sensors and Transducers	3	0	3	MR	PHYCS 102	Yes

### Year 2 - Semester 4

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
EENG 209	Introduction to Signals and Systems	3	1	3	MSR	MATHS 205 & EENG 109	No
EENG 259	Digital Systems	3	1	3	MSR	EENG 269	No

MATHS 203	Calculus III	3	0	3	CR	MATHS 102	No
PICENG 214	Computer Applications in Instrumentation and Control	0	6	2	MR	PICENG 111 & CSC 103	Yes
PICENG 216	Transport Processes II	3	1	3	MR	PICENG 213	Yes
PICENG 226	Instrumentation I	3	0	3	MR	PICENG 215	Yes
PICENG 290	Junior Project	0	3	1	MR	PICENG 215 & PICENG 242	Yes

### Year 3 - Semester 5

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
ARAB 110	Arabic Language Skills	3	0	3	UR	-----	No
CHEMY 313	Analytical Chemistry for Process Instrumentation and Control Engineering	2	3	3	MSR	CHEMY101	No
CHENG 316	Numerical Analysis	3	1*	3	MR	MATHS 205	Yes
EENG 349	Electrical Machines	3	1	3	MSR	-----	No
PICENG 331	Process Dynamics and Simulation	3	1*	3	MR	MATHS 205 & PICENG 214	Yes
STAT 273	Probability and Statistics	3	0	3	CR	MATHS 101	No

### Year 3 - Semester 6

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
MENG 300	Engineering Economics	3	1*	3	CR	Completion of 60 credits	No
PICENG 321	Instrumentation II	3	1*	3	MR	PICENG 226	Yes
PICENG 322	Analytical Measurement Systems I	3	0	3	MR	PICENG 226	Yes
PICENG 325	Microprocessors in Process Automation	3	1	3	MR	CSC 103 & EENG 259	Yes
PICENG 326	Process Instrumentation/Control Lab I	0	6	2	MR	PICENG 226 & PICENG 242	Yes
PICENG 332	Process Control I	3	1*	3	MR	PICENG 331	Yes

### Training Requirement

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
PICENG 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			
HIST 122	Modern History of Bahrain and Citizenship	3	0	3	UR	-----	No
PICENG 425	Analytical Measurement Systems II	3	0	3	MR	PICENG 322	Yes
PICENG 433	Digital Process Control	3	1*	3	MR	PICENG 325 & PICENG 332	Yes
PICENG 434	Process Control II	3	1*	3	MR	PICENG 332	Yes
PICENG 490	Senior Project	0	9	3	MR	Completion of 85 credits & PICENG 290	Yes
PICENG 4xx	Elective I	3	0	3	ME	As per ME list	Yes

### Year 4 - Semester 8

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
ISLM 101	Islamic Culture	3	0	3	UR	-----	No
PICENG 400	Engineering Ethics	2	0	2	MR	Completion of 85 credits	Yes
PICENG 411	Process Instrumentation/Control Lab II	0	6	2	MR	PICENG 226 & PICENG 332	Yes
PICENG 422	Process Control Design Project	0	9	3	MR	PICENG 433	Yes
PICENG 491	Seminar	0	2	1	MR	Completion of 85 credits	Yes
PICENG 4xx	Elective II	3	0	3	ME	As per ME list	Yes

\* Tutorial hour. Otherwise, “PRAC” refers to lab hours, or lab and Tutorial hours (MR course), or training hour.

## Major Elective Courses<sup>1</sup>

<sup>1</sup> Student must choose two elective courses from Major Elective Courses list.

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
CHENG 460	Quality Assurance and Reliability Engineering	3	0	3	ME	MENG 300 & STAT 273	Yes
PICENG 443	Industrial Safety	3	0	3	ME	PICENG 332	Yes
PICENG 450	Nonlinear Process Control	3	0	3	ME	PICENG 332	Yes
PICENG 451	Process Optimization	3	0	3	ME	CHENG 316	Yes
PICENG 456	MPC and Adaptive Control	3	0	3	ME	PICENG 433	Yes
PICENG 457	Neural Networks and Fuzzy Logic Control	3	0	3	ME	PICENG 433	Yes
PICENG 458	Logic Controllers and Distributed Control Systems	3	0	3	ME	PICENG 325	Yes
PICENG 461	Special Topics	3	0	3	ME	Department consent	Yes
PICENG 463	Fiber Optics and Laser Instrumentation	3	0	3	ME	PICENG 322	Yes
PICENG 464	Virtual Instrumentation	3	0	3	ME	PICENG 321	Yes

## Course Description

**Course Code:** PICENG 111

**Course Title:** Introduction to Process Engineering

Units and dimensions. Process and process variables. Process flowchart. Material balances with and without chemical reactions including bypass and recycle. Gas laws, compressibility factor. Multiple-phase systems. Forms of energy. Energy balance for open and closed systems. \*(One tutorial hour)

**Course Code:** PICENG 212 **Course Title:** Process Thermodynamics

Basic concepts, thermodynamic systems, processes and properties. Ideal and real gases. Energy and the first law of thermodynamics. Energy conversion and the second law. Analysis of closed and open systems. Physico-mechanical processes: power generation, refrigeration, heat pumps and liquefaction of gases. Analysis of chemical systems: work requirement for simple separation systems, energy balance with chemical reaction, calculation of heat effects and chemical reaction equilibrium. \*(One tutorial hour)

**Course Code:** PICENG 213

**Course Title:** Transport Processes I

Fluid statics, manometry and force on submerged bodies. Momentum transfer in a fluid and viscosity. Momentum balance, basic equations of fluid mechanics and examples of analytical solutions. Dimensional analysis and frictional loss calculation. Flow measurement. Pumps and compressors. Performance characteristics of pumps and compressors and their control.

**Course Code:** PICENG 214

**Course Title:** Computer Applications in Instrumentation and Control

Classification of Engineering Software. MATLAB programming environment, array and matrix operations, graphing, variables and text string manipulation, files and I/O statements, control flow and looping, functions, script files, symbolic processing. Simulation using SIMULINK; interaction between SIMULINK and M-file, S-function. Selected toolboxes. Applications using other available software packages.

**Course Code:** PICENG 215**Course Title:** Sensors and Transducers

Importance of measurement in process control and monitoring. Components of a measurement system. Static and dynamic characteristics of measurement systems. Error analysis and data representation. Sensors: resistive, inductive and capacitive sensors; resistance strain gage and piezoelectric sensors. Signal conditioning elements and schemes. Common data presentation devices and their characteristics. Calibration of measurement systems.

**Course Code:** PICENG 216**Course Title:** Transport Processes II

Heat transfer: modes of heat transfer, steady state conduction through regular surfaces, convective heat transfer, radiation heat transfer in furnaces and boilers, heat exchangers. Mass transfer: diffusion and inter-phase mass transfer, vapor-liquid separation processes and distillation, gas-liquid processes, membrane processes, basic instrumentation and control of distillation systems and RO plants.

**Course Code:** PICENG 226**Course Title:** Instrumentation I

Measurement of displacement, strain, force and torque. Pressure, level, temperature and flow rate measurement systems. Transmitters: pneumatic and electrical. Electrical and electronic measurement. Recent developments in transducers: optical fiber-, smart- and micro-sensors.

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

Technical Report Writing and Presentation prepares students to design and compose effective technical documents, with particular emphasis on technical reports and oral presentation. The lecture hour is dedicated to theories, techniques and presentations. The tutorial hour is assigned to discuss the writing reports feedbacks. \*(One tutorial hour)

**Course Code:** PICENG 290**Course Title:** Junior Project

The course is meant to develop creative design skills in the students by exposing them to some ongoing important projects in the country and requiring them to submit report on a chosen project highlighting various design components. Field trips may be arranged in coordination with the industry. The project will emphasize independent learning and teamwork. The lectures will include introduction to process instrumentation and control engineering profession, description of various areas of specialization, professional report writing techniques and the role of process instrumentation and control engineers in the society.

**Course Code:** PICENG 321**Course Title:** Instrumentation II

Final control elements: switches, motors and valves. Control signal conversion systems: analysis and design. Control valves: types, selection, sizing, characteristics, actuators and positioners. Valve dynamics. Instrumentation for safety. Data acquisition and telemetry systems: multiplexing, telemetry signals, transmission modes, modulation, analog and digital converters, field bus. \*(One tutorial hour)

**Course Code:** PICENG 322**Course Title:** Analytical Measurement Systems I

Role of analytical measurement in chemical processes. Physical property measurements: density, specific gravity, humidity, viscosity, thermal conductivity and refractive index. Chemical composition measurement: chromatographic and spectroscopic analyses. Requirement for on-line analysis: sample handling and conditioning.

**Course Code:** PICENG 325**Course Title:** Microprocessors in Process Automation

Introduction to microcontroller architecture: CPU, RAM, ROM and flash memory. Microcontroller programming. Interrupts, analog to digital conversion, digital to analog conversion. Universal asynchronous receiver transmitter. Microcontroller C language. Case studies: microcontroller application in instrumentation and control.

**Course Code:** PICENG 326**Course Title:** Process Instrumentation/Control Lab I

Laboratory safety awareness. Laboratory work on various types of physical sensors and signal conditioning systems. Error analysis and interpretation of experimental data. Measurement of major process variables such as pressure, level, temperature, flow, displacement, speed, force, etc. Calibration of transmitters and gauges. Empirical dynamic modeling of selected unit operations. Measurement of physical properties and electrochemical techniques (density, humidity, viscosity, refractive index, pH, etc.).

**Course Code:** PICENG 331**Course Title:** Process Dynamics and Simulation

Role of process dynamics and control. Development of dynamic models of several simple processes. Review of Laplace transforms. Linearization. Transfer function and state space models. Transient behavior of first- and second-order systems. Dynamic behavior of more complicated processes (high-order, time delays, lead-lag, MIMO, etc.). Frequency response. Empirical models. Simulation of the transient response using MATLAB/SIMULINK. \*(One tutorial hour)

**Course Code:** PICENG 332**Course Title:** Process Control I

Elements of a control loop, classification of control strategies. P&I Diagrams. Block diagrams. PID controllers: actions and hardware. Transient behavior of closed-loop systems. Stability: Routh, Bode and Nyquist criteria. Root locus diagrams. Controller tuning and troubleshooting control loops. Controller design: direct synthesis and frequency response methods. Feedforward, cascade, ratio, override and selective control. Interaction between process design and process control. \*(One tutorial hour)

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

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

**Course Code:** PICENG 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:** PICENG 411**Course Title:** Process Instrumentation/Control Lab II

Laboratory work on the behavior of pressure, flow, level, temperature, pH control loops. Error analysis and interpretation of experimental data. Design of experiments, controller tuning. Performance of cascade, feed forward and ratio controllers. Multivariable control of unit operation. PLC control of batch process. Characteristic and dynamic of control valves. Analytical analysis (ultra-violet/visible, infrared, chromatography (liquid and gas), etc.).

**Course Code:** PICENG 422**Course Title:** Process Control Design Project

Design of control systems for one or more unit operations or a complete plant, preferably from local industry, for which the steady state and dynamic data are made available. The students, working in groups and individuals, shall select the control system configuration(s), specify the measurement system and final control elements, select and tune the process controllers. Use of dynamic simulators is encouraged. Written design reports and oral presentations are required.

**Course Code:** PICENG 425**Course Title:** Analytical Measurement Systems II

Introduction to composition measurement and process analyzers. Spectroscopy: principles and specific type (ultra-violet/visible, infrared, x-ray mass and nuclear techniques). Chromatography: theory, data handling and calibration of gas, high performance liquid chromatography. Substance-specific methods: carbon, oxygen, nitrogen, etc.

**Course Code:** PICENG 433**Course Title:** Digital Process Control

Digital control schemes: direct digital control, distributed control systems and supervisory control. Programmable logic controllers (PLCs). Data acquisition systems. Sampling, filtering and reconstruction of signals. Development of discrete-time models. The Z-transforms. Transient response of discrete-time models. Analysis and stability of digital control systems. Digital PID controller. Design of digital controllers using direct synthesis methods. Minimum variance control and pole placement control. Batch process control and PLCs. \*(One tutorial hour)

**Course Code:** PICENG 434**Course Title:** Process Control II

Multivariable control. Relative gain analysis. Decoupling control. Singular value analysis. Multiloop controller tuning and design methods: inverse and direct Nyquist arrays. Control system design for process units and complete plants. Model predictive control: Dynamic matrix control, model predictive control and internal model control. State space analysis. Statistical process control, intelligent and robust control. \*(One tutorial hour)

**Course Code:** PICENG 490

**Course Title:** Senior Project

Students are to undertake an independent project in process instrumentation and control engineering, which may be of experimental or theoretical nature. It should demonstrate the ability of the student to define a proposition, to develop it logically and accurately and draw conclusions from the study. Upon completion of the study, written and oral presentations are required.

**Course Code:** PICENG 491

**Course Title:** 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:** CHENG 460

**Course Title:** Quality Assurance and Reliability Engineering

Quality assurance, understanding, commitment, leadership, and organization. The role of quality system, planning, flow charting. Plant quality and operation reliability maintenance. Causes and consequences of failure. Reliability of series, parallel, standby, and complex systems. Analytical methods including fault trees. Implementation methods, communication and training for quality. Guidelines for writing a quality manual.

**Course Code:** PICENG 443

**Course Title:** Industrial Safety

Introduction to industrial safety. Inherently safer and friendly design. Legislative, management and employees' responsibilities. Process safety analysis: hazard and risk analysis and assessment. Process safety devices and systems. Hazardous materials: reactive chemicals, toxic, flammable, combustible, and explosive materials. Other sources of hazards: static electricity, vacuum, inert gases, etc. Personal protection and equipment. Role of process control in process safety.

**Course Code:** PICENG 450

**Course Title:** Nonlinear Process Control

Nonlinear process models and control. Phase plane analysis. Limit cycles. Analysis and design of nonlinear process control systems using the describing function analysis. Fundamentals of Lyapunov's stability theory. Feedback linearization. Introduction to model reference adaptive control. Neural networks for nonlinear process identification and control.

**Course Code:** PICENG 451

**Course Title:** Process Optimization

Formulation of the optimization problem. Basic concepts of optimization: stationary points of a function, unimodal and multimodal functions, etc. Optimization of unconstrained single and multi variable functions: direct and indirect search methods. Linear programming and applications. Nonlinear constrained optimization problems: selected techniques. Dynamic optimization and optimal control. Case studies using available software tools.

**Course Code:** PICENG 456

**Course Title:** Model Predictive Control and Adaptive Control

Concept of model predictive control (MPC). MPC versus classical control system. Predictions for SISO models. Predictions for MIMO models. Model predictive control calculations. Tuning MPC parameters. On line process identification techniques. Introduction to adaptive control. Model reference adaptive control. Self-tuning regulators. Adaptive MPC control system. MPC Implementation. MPC control of selected unit operation models.

**Course Code:** PICENG 457

**Course Title:** Neural Networks and Fuzzy Logic Control

Neural Networks (NN): architectures of neural networks, perceptrons types. Back propagation algorithm. Process identification and control using NN. Fuzzy logic: fuzzy sets, fuzzy relations, fuzzy conditional statements, and fuzzy rules. Fuzzy logic controllers, fuzzification interface, knowledge/rule base, decision making logic, defuzzification interface, design of fuzzy logic controllers. Neuro-fuzzy and fuzzy-neural control systems.

**Course Code:** PICENG 458

**Course Title:** Logic Controllers and Distributed Control Systems

Computers in process control. Programmable logic controllers (PLCs): PLCs architecture, operation and programming, batch process control. PLCs selection, installation, troubleshooting and maintenance. Field bus, protocols. Smart devices. Distributed control systems (DCS). Local control unit (LCU) architecture, LCU languages,

LCU-process interfacing issues, communication facilities, DCS configurations, displays, redundancy concept. Case studies in DCS applications.

**Course Code:** PICENG 461

**Course Title:** Special Topics

Any important, relevant topic that is not covered in the given elective list. Topics may vary subject to students' interest and availability of staff.

**Course Code:** PICENG 463

**Course Title:** Fiber Optics and Laser Instrumentation

Principles of fiber optics. Instrumentation based on fiber optics. Optical sensors. Optical transducers. LASER beams. Instrumentation based on LASER.

**Course Code:** PICENG 464

**Course Title:** Virtual Instrumentation

Virtual Instrumentation (VI). Block diagram and architecture of virtual instruments. Programming techniques: VIs and sub-VIs, loops and conditional statements, data display, arrays, case and sequence structures and clusters, string and file I/O. Data acquisition basics: ADC, DAC, DIO, counters and timers, interrupt, software and hardware installation. VI application in measurement and control.

**Course Code:** CHEMY 313  
Engineering

**Course Title:** Analytical Chemistry for Process Instrumentation and Control

Theory of acids and bases, covalent bonding, organic functional groups, steps in a typical quantitative analysis, evaluation of analytical data. Quantitative analytical methods: Chromatography; theory, data handling and calibration of gas, high performance liquid chromatography. Spectroscopy; principles and specific types (ultra-violet/visible, infrared and atomic absorption techniques). Related practical work.

**Course Code:** CHENG 316

**Course Title:** Numerical Analysis

Selected matrix and vector operations. Numerical solution of systems of linear equations: Gauss and Gauss-Siedel. Numerical solution of nonlinear equations: bisection, Newton-Raphson and Wegstein's method. Newton's method for simultaneous nonlinear equations. Finite difference methods. Interpolation. Numerical differentiation and integration. Solution of ODE's: Euler, Runge-Kutta and shooting method. Linear and nonlinear regression. A general purpose software such as MATLAB and process engineering application examples used throughout the course.

**Course Code:** EENG 109

**Course Title:** Circuit Theory

Circuit elements; resistors, inductors and capacitors. Ohm's law. DC circuit analysis tools. Phasors and sinusoidal AC circuit analysis. Bridge circuits. Power, power factor and energy in AC circuits. Analogy between thermo-mechanical systems and electrical systems.

**Course Code:** EENG 209

**Course Title:** Introduction to Signals and Systems

Generalities of signals and signals: Classification and characteristics. LTI system characteristics. Convolution. Fourier series and harmonic analysis. Fourier transform and spectral techniques. Sampling theory and Nyquist criterion. Introduction to noise as random signals applied to LTI systems.

**Course Code:** EENG 259

**Course Title:** Digital Systems

Number Systems. Basic logic gates. Simplification of logic functions. Application of combinatorial logic circuits: Multiplexers, decoders, adders/subtractors, comparators. Memories. Programmable logic devices. Flip-flops. Analysis and design of synchronous logic gates including counters and registers.

**Course Code:** EENG 269

**Course Title:** Electronics

Ideal op. amps. Basic applications including feedback and filter design. Practical op. amp. Characteristics including common mode effect. Instrumentation amplifiers. Industrial electronic devices: Diodes, BJTs, FETs, SCRs, Triacs. Characteristics and applications to process control.

**Course Code:** EENG 349

**Course Title:** Electrical Machines

Magnetic circuits. Transformers: Basic principles and characteristics. DC motors: Basic principles, types, equivalent circuits, characteristics, and applications to process control. Synchronous and asynchronous AC motors: Basic principles, equivalent circuits, characteristics, speed control and applications. Special machines: Stepper and miniature motors with applications.

**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.

# 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.