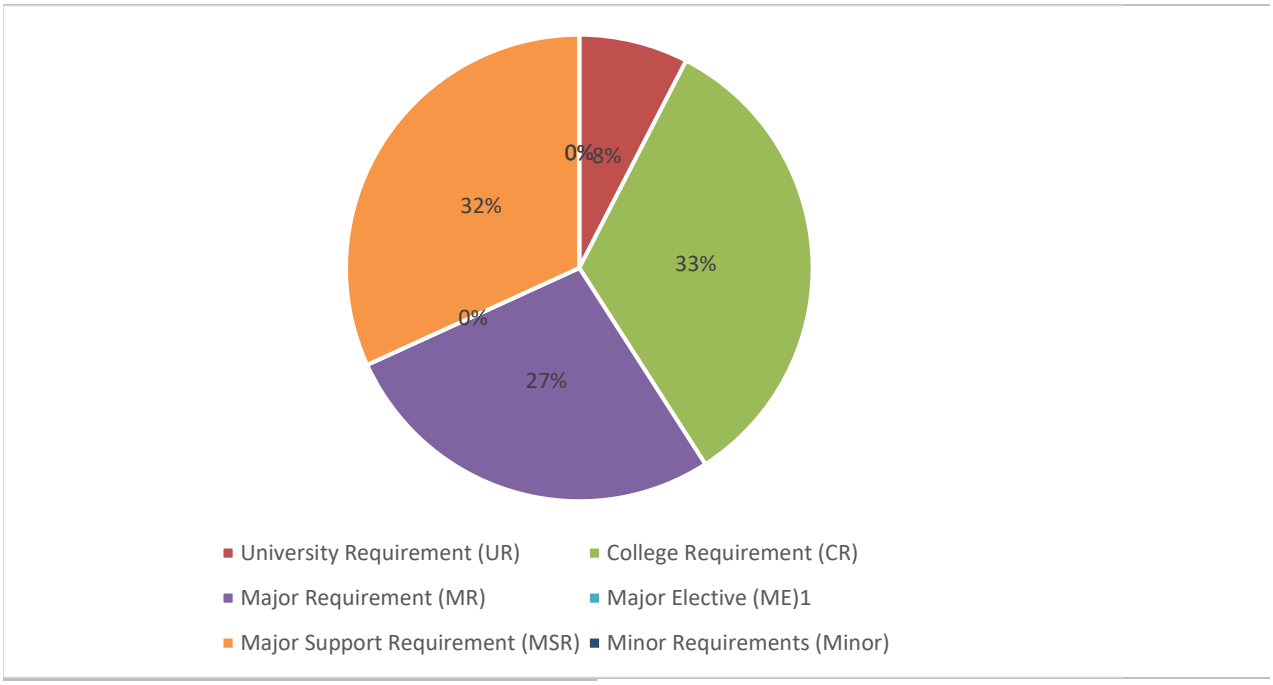
Associate Diploma in Instrumentation and Control Engineering 2025

The Instrumentation and Control Engineering 2022/2025 Associate Diploma Program for Batch 2022 Onwards

Program Components



Course Type	CRD
University Requirement (UR)	05
College Requirement (CR)	25
Major Requirement (MR)	39
Major Elective (ME)[1]	------
Major Support Requirement (MSR)	24
Minor Requirements (Minor)	------
Total Credits (CRD)	90

Detailed Study Plan

Year 1 - Semester 1

Course Code	Course Title	Course Hours			Course Type	Prerequisite	Major GPA
		LEC	PRAC	CRD			
CHEMY 101	General Chemistry I	3	2	4	CR	------	NO
ITCS 110	Computer Programming for Engineers	3	2	4	MSR	------	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	2	4	MSR	------	NO
Total		15	6	18			

Year 1 - Semester 2

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
EENG 100	Circuit Theory I	2	2	3	MSR	MATHS 101	NO
ENGL 242	Report Writing and Presentation	3	0	3	CR	ENGL 101	NO
ICENG 111	Introduction to Instrumentation and Control Engineering	2	2	3	MR	MATHS 101, PHYCS 101	YES
MATHS 102	Calculus II	3	0	3	CR	MATHS 101	NO
PHYCS 102	General Physics II	3	2	4	MSR	PHYCS 101	NO
Total		13	6	16			

Year 2 - Semester 3

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
EENG 251	Digital Systems I	2	2	3	MSR	EENG 100	YES
EENG 261	Electronic Devices and Circuits	2	2	3	MSR	EENG 100	NO
MATHS 205	Differential Equations	3	0	3	CR	MATHS 102	NO

STAT 276	Statistical Data Analysis for Engineering	3	0	3	CR	MATHS 102	YES
Total		10	4	12			

Year 2 - Semester 4

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
ICENG 220	Measurement Systems I	2	2	3	MR	ICENG 111, EENG 261, PHYCS 102	YES
ICENG 208	Computer Applications for Instrumentation and Control Engineering	0	6	3	MR	MATHS 205, ITCS 110	YES
ICENG 217	Data Communication Networks	3	2	4	MR	ITCS110	YES
ICENG 318	Microprocessors in Process Automation	3	2	4	MR	ITCS110, EENG 251	YES
ICENG 202	Thermofluid	2	2	3	MR	PHYCS 101	YES
Total		10	14	17			

Year 3 - Semester 5

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
ICENG 304	Linear Algebra and Numerical Methods	2	2	3	MR	ICENG 208, STAT 276	YES
EENG 271	Signals and Systems	3	0	3	MSR	EENG 100, MATHS 102	YES
ICENG 324	Signal Conditioning and Electronic Instruments	2	2	3	MR	ICENG 220	YES
ICENG 332	Process Dynamics and Simulation	2	2	3	MR	ICENG 208, ICENG 202	YES
Total		09	6	12			

Year 3 - Semester 6

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
ARAB 110 HIST 122 ISLM 101	Arabic Language Skills Modern History of Bahrain and Citizenship	3	0	3	UR	----------	NO

	Islamic Culture						
HRLC 107	Human Rights	2	0	2	UR	------	NO
ICENG 333	Process Control I	3	2	4	MR	ICENG 304, ICENG 332	YES
ICENG 334	Programmable Logic Controller	2	2	3	MR	ICENG 217, ICENG 318	YES
Total		10	4	12			

Training Requirement

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
ICENG 396	Industrial Training	0	6	3	MR	Completion of 85 credits	YES

***** 300 hours of supervised training.

Course Description

Description of Major Courses

Course Code: ICENG 111 **Course Title:** Introduction to Instrumentation and Control Engineering
Concept of control systems through daily life examples. Basic terminology and symbols in control systems. Benefits of control systems: social, economic, environmental, and safety impacts. Basic components of an Instrumentation and Control System. Physical systems classification: mechanical, chemical, electrical, biomedical, etc. Units and standards. Signals classification: analog and digital. Sensing element classification. Signal conditioning. Final control element types. Controller: electronic and digital. Examples of modern control-systems applications. Hierarchy of instrumentation and control system activities. Tasks and responsibilities of control and instrumentation engineers, and career opportunities.

Course Code: ICENG 202 **Course Title:** Thermofluids
Basic concepts of thermodynamics. Energy, energy transfer, and general energy analysis, properties of pure substances. The first law of thermodynamics. Mass and Energy analysis of closed systems, mass and energy analysis of open systems. The second law of thermodynamics. Introduction and properties of fluids. Bernoulli and energy equations, momentum analysis of flow systems. Internal flow. Tools: spreadsheet software (e.g., Microsoft® Excel).

Course Code: ICENG 208 **Course Title:** Computer Applications for Instrumentation and Control Engineering
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. Simulink and MATLAB M-files, S-function. Selected toolboxes. Instrumentation and control applications using available software. Tools: programming environment for calculation and simulation (e.g., MATLAB ®/Simulink).

Course Code: ICENG 217 **Course Title:** Data Communication Networks
Concepts and techniques of host-to-host computer networks and data communication. Topics include: the basics of network models, standards, and protocols, data communication systems and schemes implemented at physical and data link layers.

Course Code: ICENG 220 **Course Title:** Measurement Systems I
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 gauge, piezoelectric/piezoresistive sensors, and miscellaneous sensors. Calibration of measurement systems. Tools: spreadsheet software (e.g., Microsoft® Excel).

Course Code: ICENG 304 **Course Title:** Linear Algebra and Numerical Methods
Linear algebraic equations and selected matrix operations (e.g., Reduced row echelon form, Eigenvalues, etc.). Numerical methods and errors. Numerical solution of systems of linear equations: elimination and iterative methods . Numerical solution of nonlinear equations: bracketed and open methods. Open methods for simultaneous nonlinear equations. Interpolation and curve-fitting. Finite difference methods. Numerical differentiation and integration. Solution of ODEs - Initial Value Problems. Applications related to instrumentation and control engineering. Tools: spreadsheet software (e.g., Microsoft® Excel), programming and computing environment (e.g., MATLAB®).

Course Code: ICENG 318 **Course Title:** Microprocessors in Process Automation

Introduction to microcontroller architecture: CPU, RAM, ROM and flash memory. Microcontroller programming (Assembly and C languages). Interrupts, analog to digital conversion, digital to analog conversion. Universal asynchronous receiver transmitter. Tools: programming environment for calculation and simulation (e.g., Assembly and C language).

Course Code: ICENG 324 **Course Title:** Signal Conditioning and Electronic Instruments
Signal conditioning elements and schemes: amplifiers, AC/DC bridges, grounding, shielding, current loop, opto-isolator, V/I, F/V converters, etc. Data acquisition and telemetry systems: multiplexing, telemetry signals, transmission

modes, modulation, analog to digital and digital to analog converters. Electronic Instrument (e.g., voltmeter, ohmmeter, ammeter, power meter, frequency meter, etc.): principles of operation, applications, etc. Related laboratory experiments.

Course Code: ICENG 332 **Course Title:** Process Dynamics and Simulation
Role of process dynamics and control. Development of dynamic models of several simple processes. Review of Lapla ce 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, inverse response, lead-lag. Frequency response analysis. Multivariable process modelling. Simulation of the transient response. Related laboratory experiments. Tools: programming environment for process simulation and dynamic analysis (e.g., MATLAB®/Simulink and Control Station).

Course Code: ICENG 333 **Course Title:** Process Control I
Elements of a control loop, classification of control strategies. P&I Diagrams. Block diagrams. PID controllers and features. Transient behavior of closed-loop systems. Stability analysis. Root locus diagrams. Controller tuning. Design based on frequency response. Feedforward, cascade, inferential, override and selective control. Time delay compensation. Related laboratory experiments. Tools: programming environment for process control analysis and design (e.g., MATLAB®/Simulink and Control Station).

Course Code: ICENG 334 **Course Title:** Programmable Logic Controller
Introduction to PLC- Relay Sequencer. PLCs architecture and components. PLC operation. PLC programming languag es (LAD, FBD, Statement List, SFC-Grafcet, etc.). PLC Programming-bit logic operations, flid-flop, timers and counters, special instructions. Analog PLC operations and networking. PID Instructions. Developing Human Machine Interface (HMI) (alarm and tag management, display, etc.). Batch process control. PLCs selection, installation, troubleshooting, and maintenance. Related laboratory experiments. Tools: programming using PLC simulator software (e.g., Allen Bradley PLC simulator, Siemens PLC simulator, etc.).

Course Code: ICENG 396 **Course Title:** Industrial Training
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.

College Requirement Courses Descriptions

Description of Major Support Requirement Courses

Course Code: ITCS 110 **Course Title:** Computer Programming for 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: EENG 100 **Course Title:** Circuit Theory I
Basic quantities of electricity: Charge, Current, Voltage, Power, Energy and Resistance. Basic laws of electricity: Ohm's Law, Kirchhoff's Laws (KVL & KCL). Apply circuit theorems: mesh, nodal, superposition, Thevenin's, Norton's, and maximum power transfer. Capacitors and inductors in DC circuits. Phasors & complex numbers for AC circuits. Sinusoidal steady-state analysis. Power in AC circuits: Complex, Apparent, Real & Reactive Powers and Power Factor.

Course Code: EENG 251 **Course Title:** Digital Systems I
Number systems; Basic logic gates; Boolean algebra; Simplification of logic functions: Karnaugh maps, QuineMcCluskey 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; FlipFlops; 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 271 **Course Title:** Signals and Systems
Elementary continuous and discretetime signals, Signal decomposition and convolution, sampling theory and Nyquis t 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 an differential equations, transient and steady state time responses to elementary signals.

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: 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 242 **Course Title:** Report Writing and Presentation
This course offers theoretical and practical experience in technical report writing. It also introduces the steps involved in writing a report and in presenting its findings. The emphasis throughout is upon practical tasks and assignments, the most important of which is the production of a full-length formal report.

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 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 302 **Course Title:** Engineering Economics
Fundamentals of engineering economy. Time value of money. Present worth analysis. Annual worth analysis. Rate of return analysis. Replacement and retention analysis. Capital rationing. Breakeven analysis. Payback period analysis. Depreciation methods.

Course Code: STAT 276 **Course Title:** Statistical Data Analysis for Engineering
Introduction to statistical methods for data analysis and interpretation. Statistical concepts, probability distributions, descriptive statistics and data visualization, confidence intervals, significance tests, Analysis of Variance (ANOVA), linear and nonlinear regression analysis. Principles of design of experiments, full factorial and fractional designs, statistical quality control. Tools: spreadsheet software (e.g., Microsoft® Excel) and programming environment (e.g., MATLAB®).

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.