College of Engineering & Technology
Study Plan for Bachelor Degree
Control and Robotics Engineering Department

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Contents

College of Engineering and Technology

Study Plan for Bachelor Degree
Control and Robotics Engineering Department

Vision:
The establishment of an engineering and academic department in a modern and advanced specialization. This field covers a very wide applications in all aspects of our modern life. Control engineering and robotics technology have become an integral part of these up to date applications.

Mission:
Provide higher engineering education in the field of automation and robotics in order to support the production and services sectors with the aim to generate national economic growth. Graduate engineers capable to use and develop control and robotics systems and to conduct scientific research in this vital specialization.

Objectives:
- Provide the higher education in the country with qualitative specialization namely automation and robotics.
- Graduate engineers with the following traits:-
    - solid scientific background in basic sciences and deep understanding to the importance of this background in the control and automation.
    - The ability to handle, design and maintain automatic control, automated and robotics systems.
    - Capable of work and interaction with a multi-disciplinary teams in automated production sites.
    - Possess good communication skills in writing and speaking and be able to express thoughts and ideas and document them.
    - Have the capability to perform engineering problem solving, design experiments and model and analyze information for the development automated systems.
    - Use modern engineering and technological skills in practical application in automated projects.

- Form an academic environment to encourage staff members to perform their teaching, educational and research role in order to achieve the objectives of the department.
- Support the activities of scientific research and publication in the control and robotics field.

Learning Outcomes:

Graduate specialized engineers capable of:

- Use of control and robotics skills in industrial applications.
- Design engineering and technological production site with high specifications.
- Publishing scientific researches and books in control and automation fields.
- Provide engineering and technological consultancy and services.

Employment Opportunities:(Market)

- Control systems that include monitoring networks, industrial automation, design of alarming systems, monitoring cameras, design and programming of control cards for elevators and electric motors.
- Machine maintenance (operation and repair).
- Design software for robotic arms for automated welding and control of factory products.
- Application of automated systems in dangerous environment such as mining and deep sea work.

Subjects Coding:

Each subject is given a code consists of seven digits as shown below:

College Code		Specialization Code		Subject Level	Knowledge Field	Subject No.
7	6	5	4	3	2	1
C		D		Y	F	N

College Code I	
Code	**College**
BA	Business & Administration
ET	Engineering & Technology
NH	Natural & Health Sciences
UR	University Requirements

Specialization Code (D)	
Code	**Specialization**

BS	Basic Sciences in the College
RE	Renewable Energy
DN	Electrical Distribution Network
CR	Control & Robotics
LS	Landscape Engineering

Study Plan:

A student is awarded Bachelor degree in engineering after successfully passes (158) credit hours according to the regulations in Al-Zaytona University for Science and Technology. The credit hours are indicated in Table (1):

Credit Hours Requirements:

Table (1): Credit hours for university, college, and specialization requirements

Type of Requirements	Compulsory		Elective		Total		Notes
	No. of hours	Percentage	No. of hours	Percentage	No. of hours	Percentage	
University	**17**	**%10.75**	**0**	**0**	**17**	**%10.75**	**Less than 20%**
College	**22**	**%13.92**	**0**	**0**	**22**	**%13.92**	**Less than 15%**
Specialization	**104**	**%65.82**	**12**	**%7.59**	**116**	**%73.42**	**More than 65%**
Free Subjects	**0**	**0**	**3**	**%1.9**	**3**	**%1.9**	**Less than 5%**
Total	**143**	**%90.5**	**15**	**%9.5**	**158**	**%100**	

Knowledge Fields:

Table (2) illustrates the distribution of the theoretical subjects according to the knowledge fields.

Table (2): Theoretical knowledge fields for Control and Robotics Engineering Department

Knowledge Field		Subjects	Credit Hours
0	Supporting Subjects	General Chemistry, Calculus, General Physics, Applied Engineering Math, Differential Equations, Numerical Analysis, Statistics & Probability.	27
1	Electrical Engineering	Electrical Circuits, Electronics, Electrical Machines, Power electronics, electromagnetic.	18
2	Computer Fundamentals and applications	Digital Logic, Embedded Systems, Expert Systems, Modeling and Simulation.	15
3	Mechanics and Fluids	Engineering Mechanics, Engineering Materials, Fluids Mechanic, Mechanical and Vibrations.	12
4	Measurements, Instrumentations, and Control	Measurements & Instrumentations, Automatic Control, Modern Control Systems, Industrial Process Control, Real-Time Systems.	15
5	Signal Processing, Communication, and Computer Networks.	Digital Signal Analysis, Communications and Computer Networks.	6
6	Robotics	Programmable Logic Controllers, Automation, Robotics	9
7	Projects & Training	Graduation Projects, Field Training, Engineering Management	7

Practical Fields: These cover the following subjects;
Fluids Mechanic, Measurements and instrumentation, Electric Machines, Electric Circuits and Electronics, Digital Electronics, Robotic Systems.

1. **University Requirements:** These requirements are (17) credit hours as shown in Table (3).

Table (3): Compulsory university requirements.

Subject Code	Subject Name	No. of Hours			Prerequisite
		Th.	Pr.	Credit	
UR00101	Arabic Language Skills	3		3	
UR00111	English Language Skills(1)	3		3	
UR00112	English Language Skills(2)	3		3	English language skills(1)
UR00121	Culture & Civilization	3		3	
UR00122	History of Palestine	3		3	
UR00131	Computer Skills	1		1	
UR00141	Leadership &	1		1	

	Communication Skills				

2. **College Requirements:** These requirements are (22) credit hours as shown in Table (4).

Table (4): Compulsory college requirements.

Subject Code	Subject Name	No. of Hours			Prerequisite
		Th.	Pr.	Credit	
ETBS101	Calculus(1)	3		3	
ETBS102	Calculus(2)	3		3	Calculus(1)
ETBS111	General Physics(1)	3		3	
ETBS112	General Physics(2)	3		3	General Physics(1)
ETBS113	Physics Lab.		2	1	
ETBS131	Hand Engineering Drawing		3	1	
ETBS132	Engineering Drawing by Computer		2	1	Hand Engineering Drawing
ETBS141	Workshop(1)		3	1	Hand Engineering Drawing
ETBS142	Workshop(2)		3	1	Workshop(1)
ETBS251	Engineering Programming	2	2	3	Computer Skills
ETBS261	Engineering Ethics	1		1	English Language Skills(2)
ETBS362	Scientific Research & Technical Writing	1		1	Engineering Ethics

3. **Specialization Requirements:** These requirements are (116) credit hours distributed as follows:

(a). Compulsory Specialization Requirements: These requirements are (104) credit hours, as shown in Table (5).

Table (5): Compulsory specialization requirements.

Subject Code	Subject Name	No. of Hours			Prerequisite
		Th.	Pr.	Credit	
ETBS201	Applied Engineering Math	3		3	Calculus(2)
ETBS202	General Chemistry	3		3	
ETBS204	Differential Equations for Engineers	3		3	Applied Engineering Math.
ETRE221	Electric Circuits(1)	3		3	General Physics(2)
ETRE222	Electric Circuits(2)	3		3	Electric Circuits(1)
ETRE223	Electric Circuits Lab.		2	1	Electric Circuits(1)
ETRE224	Electronics	3		3	Electric Circuits(1)
ETRE226	Electronics Lab.		2	1	Electronics
ETBS301	Numerical Analysis for Engineers	3		3	Applied Engineering Math

ETDN221	Electromagnetic	3		3	Differential Equations for Engineers
ETBS302	Statistics & Probability for Engineers	3		3	Numerical Analysis for Engineers
ETCR222	Logic Circuits	3		3	Computer Skills
ETCR231	Engineering Mechanics	3		3	General Physics(1)
ETCR232	Engineering Materials	3		3	Engineering Mechanics
ETCR323	Embedded Systems	3		3	Logic Circuits
ETRE331	Fluids Mechanics & Hydrology	3		3	General Chemistry
ETRE332	Fluids Mechanics Lab.		2	1	Fluids Mechanics & Hydrology
ETCR433	Dynamic systems and Vibrations	3		3	Engineering Mechanics
ETCR341	Measurements & Instrumentations	3		3	Electronics
ETCR441	Measurements & Instrumentations Lab.		2	1	Measurements & Instrumentations
ETCR451	Digital Signals Analysis	3		3	Differential Equations for Engineers
ETDN311	Electric Machines	3		3	Electromagnetic
ETDN312	Electric Machines Lab.		2	1	Electric Machines
ETCR411	Digital Electronics	3		3	Electronics
ETCR342	Automatic Control	3		3	Measurements & Instrumentations
ETCR442	Automatic Control Lab.		2	1	Automatic Control
ETCR443	Modern Control Systems	3		3	Automatic Control
ETCR425	Intelligent Control Systems	3		3	Automatic Control
ETRE323	Power Electronics	3		3	Electronics
ETCR452	Communication and Computer Networks	3		3	Digital Signals Analysis
ETCR575	Engineering Economy and Administration	3		3	Differential Equations for Engineers
ETCR461	Automation	3		3	Modern Control Systems
ETCR526	Modeling and Simulation	3		3	Automatic Control
ETCR453	Programmable Logic Controllers	3		3	Embedded Systems
ETCR542	Industrial Process Control	3		3	Automatic Control
ETCR544	Real-Time Systems	3		3	Embedded Systems
ETCR462	Robotics Systems	3		3	Programmable Logic Controllers
ETCR563	Robotics Systems Lab.		2	1	Robotics Systems
ETCR471	Graduation Project(1)			1	Pass (100) Cr. Hrs.
ETCR571	Graduation Project(2)			3	Graduation Project(1)
ETCR371	Engineering Training			0	Pass (100) Cr. Hrs.

(b). Elective Specialization Requirements: This requirement is (104) credit hours, as shown in Table (6).

Table (6): Elective specialization requirements.

Subject Code	Subject Name	No. of Hours			Prerequisite
		Th.	Pr.	Credit	
ETCR527	Neural Networks and Fuzzy Logic	3		3	Intelligent Control Systems
ETCR543	Non Linear Control	3		3	Modern Control Systems
ETCR544	Digital Image Processing	3		3	Digital Signals Analysis
ETCR545	Quality Standards and Reliability	3		3	Engineering Economy and Administration
ETCR546	Flexible Manufacturing Systems	3		3	Robotics Systems

ETCR561	Safe Robotics Navigation Theories	3		3	Modern Control Systems
ETCR547	Optimal Control Theories	3		3	Modern Control Systems
ETCR562	Special Topics in Control and Robotics	3		3	Department Approval

4. **Free Subjects:** This requirement is (3) credit hours chosen from other colleges in the university.

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First Year							
First Semester				Second Semester			
Code	Subject Name	CrHr	Prerequisite	Code	Subject Name	CrHr	Prerequisite
UR00101	Arabic Language Skills	3		UR00122	History of Palestine	3	
UR00111	English Language Skills(1)	3		UR00112	English Language Skills(2)	3	English Language Skills(1)
ETBS101	Calculus(1)	3		ETBS102	Calculus(2)	3	Calculus(1)
ETBS111	General Physics(1)	3		ETBS112	General Physics(2)	3	General Physics(1)
UR00131	Computer Skills	1		ETBS113	Physics Lab.	1	General Physics(1)
ETBS131	Hand Eng. Drawing	1		ETBS132	Eng. Drawing by Computer	1	Hand Eng. Drawing
ETBS141	Workshop(1)	1		ETBS142	Workshop(2)	1	Workshop(1)
Total		15		Total		15	

Second Year

First Semester				Second Semester			
Code	**Subject Name**	**CrHr**	**Prerequisite**	**Code**	**Subject Name**	**CrHr**	**Prerequisite**
ETBS201	Applied Engineering Math	3	Calculus(2)	ETBS261	Engineering Ethics	1	English Language Skills(2)
ETBS202	General Chemistry	3		ETRE224	Electronics	3	Electric Circuits(1)
ETRE221	Electric Circuits(1)	3	General Physics(2)	ETRE222	Electric Circuits(2)	3	Electric Circuits(1)
ETCR231	Engineering Mechanics	3	General Physics(1)	ETCR232	Engineering Materials	3	Engineering Mechanics
ETBS251	Engineering Programming	3	Computer Skills	ETCR222	Logic Circuits	3	Computer Skills
				ETRE223	Electric Circuits Lab.	1	Electric Circuits(1)
				ETBS204	Differential Equations for Engineers	3	Applied Engineering Math
Total		15		Total		17	

Third Year							
First Semester				Second Semester			
Code	**Subject Name**	**CrHr**	**Prerequisite**	**Code**	**Subject Name**	**CrHr**	**Prerequisite**
ETBS301	Numerical Analysis for Engineers	3	Differential Equations for Engineers	ETBS302	Statistics & Probability for Engineers	3	Numerical Analysis for Engineers
ETDN321	Electromagnetic	3	Differential Equations for Engineers	ETRE331	Fluids Mechanics & Hydrology	3	General Chemistry
ETCR323	Embedded Systems	3	Logic Circuits	ETDN313	Electric Machines Lab.	1	Electric Machines
ETRE341	Measurements & Instrumentations	3	Electronics	ETRE332	Fluids Mechanics Lab.(*)	1	Fluids Mechanics & Hydrology
ETDN311	Electric Machines	3	Electric Circuits(2)	UR00121	Culture & Civilization	3	
				ETCR342	Automatic Control	3	Measurements & Instrumentations
				UR00362	Scientific Research & Technical Writing	1	Engineering Ethics
				ETRE326	Electronics Lab.	1	Electronics
Total		15		Total		16	

(*) Concurrent subjects.

Fourth Year							
First Semester				Second Semester			
Code	**Subject Name**	**CrHr**	**Prerequisite**	**Code**	**Subject Name**	**CrHr**	**Prerequisite**
ETCR442	Measurements & Instrumentations Lab.	1	Measurements & Instrumentations	ETRE323	Power Electronics	3	Electronics
ETCR433	Dynamic systems and Vibrations	3	Engineering Mechanics	ETCR425	Intelligent Control Systems	3	Automatic Control
ETCR451	Digital Signals Analysis	3	Differential Equations for Engineers	ETCR452	Communication and Computer Networks	3	Digital Signals Analysis
ETCR411	Digital Electronics	3	Electronics	ETCR461	Automation	3	Modern Control Systems
ETCR442	Automatic Control Lab.	1	Automatic Control	ETCR462	Robotics Systems	3	Programmable Logic Controllers
ETCR443	Modern Control Systems	3	Automatic Control	UR00141	Leadership & Communication Skills	1	English Language Skills(2)
ETCR453	Programmable Logic Controllers	3	Embedded Systems				
Total		17		Total		16	

Fifth Year							
First Semester				Second Semester			
Code	Subject Name	CrHr	Prerequisite	Code	Subject Name	CrHr	Prerequisite
ETCR575	Engineering Economy and Administration	3	Differential Equations for Engineers	ETCR571	Graduation Project(2)	3	Graduation Project(1)
	Elective (1)	3	Pass (100) CrHr	ETCR542	Industrial Process Control	3	Automatic Control
	Free Subject	3		ETCR526	Modeling and Simulation	3	Automatic Control
ETCR471	Graduation Project(1)	1	Robotics Systems		Elective (3)	3	Pass (100) CrHr
ETCR545	Real-Time Systems	3	Embedded Systems		Elective (4)	3	Pass (100) CrHr
	Elective (2)	3	Pass (100) CrHr	ETCR563	Robotics Systems Lab.	1	Robotics Systems
Total		16		Total		16	

Control and Robotics Engineering
Course Description

Subject	Description
Calculus(1) ETBS101	Review of functions: notation, operations, Limits and continuity, including trigonometric functions, Derivatives: rates of change and techniques of differentiation, including trig functions, Function composition, chain rule, and implicit differentiation, Applications of derivatives: related rates and optimization problems, Exponential and logarithmic functions — graphs, derivatives, and applications, Inverse trigonometric and hyperbolic functions — graphs, derivatives, and applications, improper integrals, Techniques of integration — integration by parts, integration by partial fractions.
Calculus(2) ETBS102	Sequences and series, power series, convergence theorems: integral, ratio, and alternating-series tests, Polar coordinates and functions, integration and differentiation of polar functions, Vectors in three-

	dimensional space, spherical and cylindrical coordinates, Vector valued functions, Partial derivatives, multiple integrals, Topics in vector calculus.
General Physics(1) ETBS111	Physics and measurement, Motion in one dimension, Vectors, Motion in two dimensions, Force and motion, Kinetic energy and work, Potential energy and conservation of energy, Linear momentum and collisions, Rotation, Rolling and angular momentum.
General Physics(2) ETBS112	Electric Fields, Gauss's Law, Electric Potential, Capacitance and Dielectrics, Current and Resistance, Direct Current Circuits, Magnetic Fields, Sources of the Magnetic Field, and Faraday's Law.
Physics Lab. ETBS113	Developing a good understanding of a few important concepts in Mechanical physics, Learning to apply these concepts to familiar and unfamiliar situations and Gaining the ability to reason qualitatively and quantitatively about Mechanics.
Hand Engineering Drawing ETBS131	Orthographic and Isometric projections; Sketching, sectioning, dimensioning and layering. Introduction to descriptive geometry, perspective drawing. Engineering applications**.**
Engineering Drawing by Computer ETBS132	The Use of AutoCAD software in Engineering drawing. Geometric constructions and layering. Plotting to scale, blocks and attributes,
Workshop(1) ETBS141	General safety, materials and their classifications, measuring devices and their accuracy. Practical exercises including fitting, forging, carpentry, casting, welding, mechanical saws, shearers, drills, lathes, milling machines, shapers and grinders.
Workshop(2) ETBS142	Electrical installations, electric motor maintenance and operation, simple electric circuits design and implementation, Use and training on CNC machines, Design and production of domestic and office items.
Engineering programming ETBS251	Concepts of computer programming languages, C++ basic programming fundamentals, data types "variable and constants", all types of mathematical and logical operations, control and repetitive instructions, methods of algorithmic study and analysis, declaration of one and two dimensional arrays, pointers declaration, series operations, types of files and templates.
Engineering ethics ETBS261	Understand social values and local costumes, respect from personal and professional perspective, concept of honesty from general and engineering point of view, scheduling and accurate time keeping, good manners in discussions and debating, proper rules to contract drafting and implementation and engineering refereeing, proper financial documentation.
Scientific Research and Technical	Objectives and directions of scientific research, methods of scientific problems identifications, processing approach for

writing ETBS362	scientific research, data and information collections and analysis, possible alternative solutions, selection methods for the proper solution, results evaluation, economics of scientific research, scientific documentation, methods and approaches of technical writing, good command of technical English.
Applied Engineering Math ETBS201	Infinite Series; Infinite series of constant terms, Convergence tests, Power series and radius of convergence, Taylor and Laurent series. Linear Algebra; Vector analysis in Cartesian coordinates; Curvilinear coordinates and transformations to Cartesian, Spherical, and Cylindrical coordinates; Matrices and linear equations; Matrices and Linear Operators; Determinants, Eigenvalues and eigenvectors. Complex Numbers and Complex Variable; Representation of complex numbers, DeMoivre's formula, Powers and roots of complex numbers, Functions of complex variable.
General Chemistry ETBS202	Stoichiometry of formulas and equations. Gases and the kinetic-molecular theory. Quantum theory and atomic structure. The components of matter. The major classes of chemical reactions (precipitation, acid-base, oxidation-reduction, and reversible reactions). Thermodynamics: energy flow and chemical change. Quantum theory and atomic structure. Electron configurations and chemical periodicity. Kinetics: rates and mechanisms of chemical reactions. Equilibrium: The extent of chemical reactions.
Differential Equations for Engineers ETBS204	Ordinary differential equations' Sturm-Liouville theory, properties of Special Functions, Solution methods including Laplace transforms, Fourier series: eigenvalue problems and expansions in orthogonal functions. Partial differential equation: classification, separation of variables, solution by series and transform methods. Models in Applied Mathematics; Applications to illustrate typical problems and methods of applied mathematics in solid and fluid mechanics, fields of physics, deformation and vibration, wave phenomena, diffusion phenomena, heat conduction, chemical and nuclear reactors, and biological processes.
Electric Circuits(1) ETRE221	Overview: SI units , voltage and current; Ohm's and Kirchhoff"s Laws, circuits with dependent sources; simple resistive circuits: series, parallel and delta to wye; Techniques of circuit analysis: nodal and mesh analyses, source transformation, Thevenin and Norton equivalents; Amplifiers; Inductance, capacitance and mutual inductance; Natural and step responses of RL and RC circuits; Natural and step response of series and parallel RLC circuits; Sinusoidal steady state analysis.
Electric Circuits(2) ETRE222	Calculating average and reactive power, power in parallel loads, maximum power transfer. Analysis of 3-phase circuits: calculating wattmeter readings in 3-phase circuits. Introduction to Laplace Transform: poles and zeros, initial- and final value theorems. The

	Laplace Transform in circuit analysis. Active filter circuits. Fourier series. The Fourier Transform. Two-port circuits.
Electric Circuits Lab. ETRE223	Resistive circuits, Potentiometers, Superposition, Thevenin's theorem and maximum power transfer, RLC current and voltage characteristics, Frequency response of RL, RC and RLC circuits, Series and parallel resonant circuits, Amplifiers.
Electronics ETRE224	Introduction to semiconductor electronic devices. Semiconductor p-n junction, the transistor. Analysis and synthesis of linear and nonlinear electronic circuits containing diodes and transistors. Elementary analog circuit analysis. Fundamentals of transistors and voltage amplification. Characterization of MOS transistors for circuit simulation. Common-source amplifiers, MOSFET source-follower buffer stage, differential amplifier stage, and MOSFET current sources. Operational amplifiers. Development of a Basic CMOS Operational amplifier.
Electronics Lab ETRE226	Diode characteristics, diode limiters and clampers. Rectifiers and Zener diode regulation. Bipolar junction transistor. Common collector and common base. FET and common Source. Frequency response. Multistage Amp. Differential Amp. Inverting and noninverting Amp. Oscillators.
Numerical Analysis for Engineers ETBS301	Introduction into numerical analysis. Introduction and practice in programming of Matlab and Simulink. Representation of data and numerical errors. Numerical Methods for the solution of systems of linear algebraic and differential equations. Matrices and their properties. Classification of systems of linear algebraic equations. Matrix factorization. Gauss elimination algorithm. Cholesky algorithm. Iterative methods (Jacobi, Gauss-Seidel) and their convergence. Eigenvalues and eigenvectors. Euler and Runge-Kutta methods and their properties for solving ordinary differential equations.
Electromagnetic ETDN221	Vector operation and coordinate systems. Electric filed due to point. Line. Surface. And Column Charges. Electric Flux Density. Gauss Law and Divergence Theorem. Boundary Conditions. Capacitor and Energy. Steady Electric Current. Conductivity. Ohm's Law. KCL. Biot-Savant Law and Magnetestic Field. Magnetic Flux Density. Ampere's Law and Stock's theorem. Magnetic Vector Potential. Inductance and Energy. Ferromagnetic Material and the Magnetic Circuits. Introduction to Time Varying Field.
Statistics & Probability for Engineers ETBS302	Probability, Discrete Distributions and their applications, Continuous Distributions and their applications, Estimation of parameters, Hypothesis testing, Regression, Quality control for engineers.

Logic Circuits ETCR222	Different types of number systems, Boolean algebra, Boolean operations, synchronous logic circuits, analysis and design of sequential circuits, Counters and registers, types of memories.
Engineering Mechanics ETCR231	Types of forces and resultants, torque calculations for different dynamic systems, balance theories, bending moment calculations, center of gravity, moment of inertia, Newton first and second laws, work and energy.
Engineering Materials ETCR232	It covers the atomic structures and covalent, types of materials (metal, polymer, ceramics, and compound materials), elasticity of alloys, different material curves and phases, Ferro and non-Ferro materials.
Embedded Systems ETCR323	Introduction to Microprocessors, microcomputers and microcontrollers. Architecture of single-chip microcomputers. Interfacing and programming of single-chip microcontrollers. Assembly language programming, C language programming. System design based on a single-chip. Introduction to wireless sensor networks. Engineering applications.
Fluid Mechanics & Hydrology ETRE331	Physical properties of fluids and fundamental concepts in fluid mechanics, hydrostatics, conservation laws for mass, momentum and energy, flow similarity and dimensional analysis as applied to engineering problems in fluid mechanics, laminar and turbulent flow, engineering applications such as flow measurement flow in pipes and fluid forces on moving bodies.
Fluid Mechanics Lab. ETRE332	Measurement of thermal conductivity, forced convection heat transfer, measurement of specific heat ratio, flow through nozzles, losses in pipes and fittings, hydrostatic pressure, impact of water jet, flow visualizations, performance of hydraulic positive displacement pumps.
Dynamics Systems & Vibrations ETCR433	This subject covers the modeling of dynamic systems (using newton second law), electrical and thermal energy and fluid systems, modeling and simulation of different types of systems using Laplace transform of linear and partial differential equations, time and frequency responses analysis.
Measurements & Instrumentations ETCR341	Measurement and errors. Units and standards. Analog meters. Potentiometers. DC and AC bridge instruments. Transformers. Electronics measuring instruments. Oscilloscope. Frequency and phase measurements. Transducers
Measurements & Instrumentations Lab ETCR441	Sensitivity of Wheatstone bridge. Wien bridge. Capacitance measurement. FM-instrumentation for capacitive and inductive transducers. Strain-gage. Thermistor. Platinum thermometer. Temperature-control. Photodiode. Photovoltaic-cell. Spectral and polar responses of photo transducer.

Digital Signal Analysis ETCR451	Classes of signals and systems. Fourier series and transform. Convolution and impulse response. Correlation and power spectral density. Theory and design of digital filters. Discrete Fourier series and FFT. X-transform. Computer applications.
Electric Machines ETDN311	Transformers. DC Motors and Generators. Three-Phase Induction motors. Single-Phase Induction Motors. Three-Phase Synchronous Generator and Motor. Single-Phase Synchronous Generator and Motor. AC Series Motor. Repulsion Motor
Electric Machines Lab ETDN312	Experiments on transformers. DC Motors and Generators. Single and Three Phase Induction Motors. Single and Three Phase Synchronous Generators and motors. AC Series Motors.
Digital Electronics ETCR411	Semiconductor devices and switching characteristics. Logic agates and families. Memory elements and types. Timing circuits. Programmable Logic Devices Analog/digital and Digital / Analog convectors. Visual Display.
Automatic Control ETCR342	Introduction to Feedback System. Review of System Equations. Block Diagram and Signal Flow Graphs. Time Response of Systems and Closed Loop Performance. Routh's Stability Criterion. The Root Locus Method. Frequency-Methods. Compensation Techniques. Introduction to Sampled Control System.
Automatic Control Lab. ETCR442	Open and Closed Loop System Servomechanism Principles. The Effect of Gain. Integral Control, Proportional Control. Derivative Control and Velocity Feedback on System Performance. Frequency Response Measurement
Modern Control Systems ETCR443	Revision for linear algebra and matrices, time variant and invariant systems, linear systems: monitoring and control, stability of linear and non-linear systems, feedback control systems design, introduction to optimal control theories, adaptive control theories.
Intelligent Control Systems ETCR425	Introduction to artificial intelligence, knowledge acquisition methods and different inference engines, dealing with vague information, hybrid expert systems, expert systems programming languages, design and implementation of intelligent systems in engineering applications.
Power Electronics ETRE323	Power semiconductor devices: types, drive circuits, protection circuits and power loss calculations. AC-DC converters: uncontrolled, half-controlled and fully controlled single-phase and three-phase rectifiers. AC-AC converters: cyclo-converters. DC-AC inverters: single-phase and three-phase. DC-DC converters' topologies analysis and design: step-down, step-up, and step-down/up converters.
Communication and Computer Networks ETCR452	It deals with kinds of data transmission techniques, physical and electrical layer of connectors, bandwidth selection, data, networks, and transmission layers, TCP/IP protocols, types of addressing, types of LAN, internet web, switches and repeaters, introduction to

	WAN.
Engineering Economy and Administration ETCR575	Engineering decision making, financial and technical background, comparison method between different alternatives using economical strategies, engineering project evaluation skills, basic concepts of engineering economics, management of engineering projects, case studies.
Automation ETCR461	Introduction to the fundamentals of production and assembly lines, different types of automation, PLC, CNC machines, industrial robotics, automated material handling methods, automated storage systems, hydraulic and pneumatic systems, CAD.
Modeling and Simulation ETCR526	Modeling of physical systems, sequence of system analysis, solution strategies, system model verification, simulation of discrete systems, using performance indices through simulation languages to confirm the design implementation.
Programmable Logic Controllers ETCR453	PLC block diagrams, PLC architecture, input-output units addressing, programming using ladder diagram, internal relays, timers, counters, registers, processors, types of instructions, tests and validation techniques, applications.
Industrial Process Control ETCR542	Industrial process molding, study and analysis techniques, sensors and actuators (motors and valves), transmitters, MIMO industrial plants, PID tuning and control, applications.
Real Time Systems ETCR544	Introduction to real-time computer control systems, Hard and soft real-time systems. Microcomputer interfacing, Discrete system analysis, Discrete transfer functions, z-transform. Controllers implemented in real-Time systems. Implementation of real-time algorithms. Implementation of the basic PID algorithm in real-time, Synchronization of the control loop, Timing Considerations in implementation of Control Loops. Real-time operating systems. Engineering applications.
Robotic Systems ETCR462	Mathematical modeling of mechanical robot components and its different analysis methods, dynamic of robot motors and applied forces and velocities, design of feedback loop using different control theories in designing controllers.
Robotic Systems Lab. ETCR563	Various experiments related to robotic systems course.
Graduation Project(1) ETCR471	The student will be allocated a project and a supervisor at the first week of the semester. The student studies and analyses the project and presents a suggestion to implement the project in graduation project (2).
Graduation Project(2) ETCR571	The student implement the project allocated by the department in view of the results from graduation project (1).
Engineering	The student undergo field training for eight weeks after passing 90

Training ETCR371	credit hours. The training will be in approved industrial engineering sites. The training is supervised by a member of staff from the department. Periodic reports about the progress of the training. The student should submit final report and undergo final examination, The training should be in a complete semester without any courses.
Neural Networks and Fuzzy Logic ETCR527	Introduction to NNs, comparison with traditional methods, learning process, NNs different topologies, EBP NN learning algorithm features, introduction to fuzzy logic, fuzzy operations, fuzzifiction and defuzzification methods, fuzzy production rules and its inference machine, Mamdani fuzzy control algorithm, engineering applications.
Non-Linear Control ETCR543	Introduction in the control of non-linear systems and its analysis, design of nonlinear controllers, special sensors and actuators and drive systems selection, application on robotic systems both using simulation and real time experimentation **.**
Digital Image Processing ETCR544	Introduction to discrete systems, digital image representation both in time and frequency domains techniques, image features enhancement, size reduction methods, image reconstruction, .advanced topics to analyze and classify digital images.
Quality Standards and Reliability ETCR545	Fundamentals of probability theorems, probability distribution, system evaluation and reliability, types of faults, random operations, Marcof process, reliability of series and parallel systems, planning of eliability templates, methods of quality assurance measurement, engineering tolerances, quality curves, statistical analysis for quality assurance data, quality tests, quality management and cost..
Flexible Manufacturing Systems ETCR546	History of flexible manufacturing systems (FMS), FMS types and components, FMS development and degree of flexibility in engineering applications.
Safe Robotics Navigation Theories ETCR561	Introduction to robotics, modern aspects of robotics intelligent systems, planning and executing safe robotic navigation in an unknown environment, path planning techniques, engineering applications.
Optimal Control Theories ETCR547	It concentrates on the basic theories of optimal control, analysis of dynamic systems in continuous domain, analysis of optimal control for nonlinear systems, H∞ : theory and applications in robotic systems.
Special Topics in Control and Robotics ETCR562	Special topics in control and robotics. To be approved by the departmental board.

Control and Robotics lab : Equipment's

Item	Description	Qty
A	**CONTROL LAB مختبر التحكم**	
	The system to have the possibility to work manually without PC and also to have the possibility to run through PC and software To include the following :	
1	**Computer interface unit with Software for the Control Lab** **External Interface with USB to connect each of the bellow mentioned controls trainers to PC**	8
2	Universal DC/AC Power supply base unit for control lab كل وحدة تأخذ 2-3 طلبة، ليكون المجموع بين 16 – 20 طالب في المختبر	**8**
3	System to Study Temperature control كل لوحة تعمل على وحدة واحدة من ال8 وحدات وهكذا.	**1**
4	System to Study light control	**1**
5	System to Study Pressure control	**1**
6	System to Study Speed and Position Control of Permanent magnet motors	**1**
7	System to Study Fluid pressure , Level & flow Control Trainer	**1**

8	System to Study PWM Control of DC motor	**1**
9	System to Study Stepper motor control	**1**
10	System to Study Control of Three phase motor	1
11	System to Study Control processes Principles , P/I/D , PID control	**6**
12	Inverted Pendulum Control Trainer	1
13	Magnetic Levitation Control Trainer	1
14	Mass and spring control	1

B	**ROBOT LAB مختبر أنظمة روبتكس**	
Item	**Item Description**	**QTY**
1	**Educational Arm Robot**	**8**
2	**Educational Industrial Arm Robot with machine vision system**	**1**

3	**Mobile Training Robot**	**8**