المملكة العربية السعودية
المؤسسة العامة للتدريب التقني والمهني
الإدارة العامة للمناهج

KINGDOM OF SAUDI ARABIA
Technical and Vocational Training Corporation
Director General for Curricula

المؤسسة العامة للتدريب التقني والمهني
Technical and Vocational Training Corporation

نسخة أولية

الخطط التدريبية للكليات التقنية
Training Plans for Colleges of Technology

CURRICULUM FOR

Department
Electronics Engineering

Major
Industrial Electronic and Control

A Bachelor's Degree

Semesters
1439H - 2017

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Program Description

This Bachelor program prepares trainees for entry-level positions in the professions of the electronics and control industry. It is designed according to international standards to meet the market needs of local and regional employment. The trainees can deepen their skills in the fields related to industrial electronics as well as control and robotics. Bachelor's Degree in Industrial Electronics and Control is a practical degree. It is present in a various working environments related to industrial process control, transportation, mechatronics, embedded systems ect…

General modules are concentrated in the first and second semesters while the credit hours of the specialized modules will be the majority during the rest of the training period. This training program includes general skills in mathematics, physics, computer programming, computer aided design and English language. The specialized skills cover the modules of analog and pulse circuits, digital systems design, Embedded Systems, Electric drives, Robotics ect…,

For more flexibility in the training system, the program includes elective tracks modules during the third and the fourth semester. We have defined three optional modules per semester and the student must choose an optional module per semester.

In this training program, trainees must spend 1840 hours of training at the faculty.

The Theoretical and Practical Tests and Graduation Projects Determine Learning Outcomes and Trainee Levels for each program.

The training courses contain a theoretical part and a practical part. The practical part is tested as a practical test and the theoretical part is a theoretical test with different evaluation methods

The Bachelor Degree Graduate gets the seventh level in the Saudi Arabian Qualifications Framework (SAQF).

Admission Requirements: The applicant must have a diploma in Industrial Electronic and Control.

Brief Description

Course Name	Circuit analysis	Course Code	ELCC 333	Credit Hours	4
Description	The goals for this course are to provide the student with an understanding of, and a proficiency in the analysis of Different types of power and power factor correction, Balanced/unbalanced, three-phase circuits, considering the power generation and distribution, Transient and steady state behavior of RL RC and RLC circuits, Different types of filters and the series/parallel resonance circuits, Frequency response of a circuit using the s-plane representation and analysis, Bode Plots and computer-aided methods.				

Course Name	Computer Aided Design	Course Code	ELCC 331	Credit Hours	2
Description	This course gives the trainees the fundamentals of the computer aided design for electronic circuits. Trainees will use Matlab software, one of the most popular computer aided design programs for engineering. Special emphasis is placed on the Overview of Matlab Simulink. The toolbox, Graphics Mode, Editing a new design, Placement, Edit the characteristics of a component, Adding a generator, Edition of the characteristics of the generator, Simulation, The measuring instruments, Preparation routing.				

Course Name	Analog and pulses Circuits	Course Code	ELCC 342	Credit Hours	3
Description	The course introduces analog electronics, with little mathematical or physical analysis and much opportunity to design and build circuits. The treatment moves quickly from fundamentals (for example, passive circuits made with resistors, capacitors) to designs with transistors and then gives most of its attention to the design of circuits using operational amplifiers: circuits such as integrators, amplifiers, oscillators, filters, and a servo loop.				

Course Name	Signals and systems	Course Code	ELCC 321	Credit Hours	3
Description	The objectives of this course are to introduce students to the basic concepts of signals, system modeling, and system classification; to develop students' understanding of time-domain and frequency domain approaches to the analysis of continuous and discrete systems; to provide students with necessary tools and techniques to analyze electrical networks and systems; and to develop students' ability to apply modern simulation software to system analysis.				

Course Name	Sensors and actuators	Course Code	ELCC 322	Credit Hours	3
Description	Sensors and actuators are two critical components of every closed loop control system. The main purpose of this course is to provide the most fundamental knowledge the physics principles, operating mechanisms of various kinds of sensors. Actuators and their role in automatic control, pulse width modulation technique for power control. Examples in temperature, speed and light control systems.				

Course Name	Digital Systems Design	Course Code	ELCC 328	Credit Hours	4
Description	This course gives trainees the fundamentals of the digital systems. Their different architectures and their use within electronic system design. Digital Logic Design with VHDL as well as Digital Signal Processing DSP will be studied. Interfacing Digital Logic to the Real World (A/D Conversion, D/A Conversion) will be emphasis.				

Course Name	Industrial Process Control	Course Code	ELCC 432	Credit Hours	3
Description	The main objective of this course is to describe the basic knowledge of the process measurement, error detection and control elements, PLCs and its application in industry and design parameters of control system. After accomplishment of this course, the students will be able to design and implement industrial process control applications through ladder diagrams using industrial process input and output devices.				

Course Name	ElectroMechanical Systems	Course Code	ELCC427	Credit Hours	2
Description	The Electro Mechanical Systems unit of study introduces the trainees to electrical actuators, electro-hydraulic systems, Analysis of common power electronic schemes required for electromagnetic motion devices. Modeling and simulation of electrically driven magnetic motion systems and drive electronics using MATLAB and Simulink. Equations of motion governing DC and AC motors. Performance characteristics of various DC and AC Motor Designs simulated using MATLAB and Simulink				

Course Name	Power Electronics	**Course Code**	ELCC452	**Credit Hours**	4
Description	This course examines the application of electronics to energy conversion and control. Topics covered include: modeling, analysis, and control techniques; design of power circuits including inverters, rectifiers, AC-AC and DC-DC converters; analysis and design of magnetic components and characteristics of power semiconductor devices. Numerous application examples will be presented such as Aerospace, Railway, Electrical Automotive, Solar, Lighting, Power supplies, both theoretical and practical laboratory simulations				

Course Name	Embedded Systems	**Course Code**	ELCC 329	**Credit Hours**	3
Description	Embedded systems are involved in almost every facet and modern life. Cell phones, pagers, PDAs answering machines, microwaves ovens, televisions, video games, consoles, GPS devices and networks routers. Late model cars may contain as many as 65 embedded microprocessor, controlling such tasks as antilock braking, engine control, audio system control. In this course, the fundamentals of embedded systems hardware and firmware design will be discovered. Issues such us embedded processor selection, hardware- firmware partitioning, logic circuit design, circuit layout, circuit debugging, developing tools, firmware architecture, firmware design and firmware debugging.				

Course Name	Digital Communication Systems	**Course Code**	ELCC 473	**Credit Hours**	3
Description	This course covers the techniques of modern digital communication systems. Special emphasis is placed on the Review of the digital communication, Coding for discrete sources, Quantization, Source and channel waveforms, modulation, and demodulation (PSK, FSK, ASK, QAM) Introduction to Wireless communication. Students are expected to demonstrate the ability to Understand basic components of digital communication systems, Analyse and Design optimum receivers for digital modulation techniques.				

Course Name	Electric Drives	Course Code	ELCC434	Credit Hours	3
Description	Motion control in industrial, commercial and transportation systems is carried out using electrical drives. This course provides students with the working knowledge of various components of an electrical drive system and their control. After completion of this course, students are expected to select and size electrical drives for any given application in an efficient manner and should be able to perform design of different drive components. The topics covered are: characteristics and sizing of power semiconductor controlled electric drives; DC motor drives: speed and torque control; induction motor drives: voltage control and variable frequency control; synchronous motor drives: open-loop, closed-loop variable frequency control; brushless DC drives; drives application examples.				

Course Name	Robotics	Course Code	ELCC 464	Credit Hours	3
Description	Design of robotics systems that combine embedded hardware, software, mechanical subsystems, and fundamental algorithms for sensing and control to expose students to basic concepts in robotics and current state of the art. Lecture closely tied to design laboratory where students work in teams to construct series of subsystems leading to final project.				

Course Name	Digital Control System	Course Code	ELCC 437	Credit Hours	3
Description	The course introduces the fundamental concepts, principles and applications of the digital control system. The topics cover modern control design techniques, including, Discrete systems dynamics, sampled-data systems, Z-transform, digital transfer functions, state space models and digital controllers design. A number of chosen real problems are solved to illustrate the concepts clearly.				

Course Name	Programmable Logic Controller PLC Elective1	Course Code	ELCC 435	Credit Hours	4
Description	This course gives the trainees the fundamentals of Programmable Logic Controller (PLC) technology including programming techniques. The functional material design will have to be examined. The design and programming of controller circuits will be highlighted using examples from industrial applications. The application of PLC's in process automation will be studied. An overview of functional hardware design will be included. The equipment used in Laboratory will give trainees practical programming and troubleshooting skills used in industrial maintenance.				

Course Name	Artificial Intelligence Elective1	Course Code	ELCC 474	Credit Hours	4
Description	The main purpose of this course is to provide the most fundamental knowledge to the students so that they can understand what the AI is. Due to limited time, we will try to eliminate theoretic proofs and formal notations as far as possible, so that the students can get the full picture of AI easily. Students who become interested in AI may go on to the graduate school for further study. The main topics of this course include: the problem solving, reasoning, Planning, and Natural language understanding, computer vision, automatic programming, and machine learning.				

Course Name	Mechatronics Elective1	Course Code	ELCC 428	Credit Hours	**4**
Description	Modern products (such as automobiles, cameras, medical equipment, space craft, communication satellites, etc.) and manufacturing equipment(such as 3D printers, CNC machines, industrial robotics and autonomous systems, etc.) contain numerous computers and mechatronics modules. Their creations require engineers to be able to combine mechanical, electric, electronic and software subsystems using advanced scientific and engineering knowledge. This course introduces to students the basic mechatronics system components, and the design principles of using mechatronics to meet functionality requirements of products, processes and systems. Several lab-oriented assignments and team-based course projects are presented with innovative case studies in diverse application domains. The course will also prepare the students to read literature, understand research problems, and identify possible innovations to the field.				

Course Name	Renewable energy technologies	Course Code	ELCC 411	Credit Hours	2
Description	This course discusses the use of solar energy (thermal and photovoltaic), wind, geothermal, as well as energy heat transfer. The potential of using renewable energy technologies to the extent possible, replacement for conventional technologies, and the possibility of combining renewable and non-renewable energy technologies in hybrid systems. In the end of the course, students will be able to Describe the fundamentals and main characteristics of renewable energy sources and their differences compared to fossil fuels. And they can explain the technological basis for harnessing renewable energy sources Recognize the effects that current energy systems based on fossil fuels have over the environment and the society				

Course Name	Integrated VLSI Circuit Design	**Course Code**	ELCC 442	**Credit Hours**	2
Description	This is an introductory course which covers basic theories and techniques of digital VLSI design in CMOS technology. In this course, we will study the fundamental concepts and structures of designing digital VLSI systems include CMOS devices and circuits, standard CMOS fabrication processes, CMOS design rules, static and dynamic logic structures, interconnect analysis, CMOS chip layout, simulation and testing, low power techniques, design tools and methodologies, VLSI architecture. The course is designed to give the student an understanding of the different design steps required to carry out a complete digital VLSI (Very-Large-Scale Integration) design in silicon.				

Course Name	Supervision of Industrial Process **<u>Elective 2</u>**	**Course Code**	ELCC 412	**Credit Hours**	3
Description	This course reviews principles used on process supervision. The principles and methodologies of bond graph are introduced for analysis of industrial process supervision. The topics cover the bond graph model based qualitative FDI, Diagnostic and Bi-causal Bond Graphs for FDI, Actuator and Sensor Placement for Reconfiguration. Isolation of Structurally Non-isolatable Faults, Multiple Fault Isolation Through Parameter Estimation, Fault Tolerant Control.				

Course Name	Industrial Robotics <u>Elective2</u>	**Course Code**	ELCC 436	**Credit Hours**	3
Description	Understand the different types of industrial robots, components, architecture and kinematic and dynamic modeling. Different methods of programming robots are discussed. Students will gain experience in handling and programming real industrial robots. They acquire skills about design, simulate and program robotic industrial applications. Thanks to simulation proposed work the student will get by himself different functionalities about a common and commercial IDE (Integrated Development Environment) for industrial robot programming.				

Course Name	Electric vehicles Elective2	**Course Code**	ELCC 463	**Credit Hours**	3

Description	Conventional cars. Electric vehicle development history. Vehicle specifications. Architecture of Electrical vehicle system (two, three and four wheelers). Grid connected Electric Vehicle system. Hybrid vehicles with drive trains for series, parallel, combination. Automotive control area protocols. Types of motor used with special duty and constructions. Types of power storage used in Electrical vehicles. Power management system strategy and control strategy. Auxiliary electrical system in vehicles. Automotive steering systems. Automotive semiconductor devices, components and sensors. Automotive motor drives actuators and control. Testing of electric motor, controllers and hybrid electric vehicles. Safety components of Electrical vehicles. Passenger safety system.

Study Plan

Sixth Semester

No.	Course Code	Course Name	Pre. Req	No. of Units				
				CRH	L	P	T	CTH
1	MATH 301	Mathematics (1)		3	2	2	0	4
2	PHYS 301	Physics		3	2	2	0	4
3	ENGL 301	English Language (1)		3	3	0	1	4
4	ELCC 333	Circuit analysis		4	3	2	1	6
5	GNRL402	Engineering project Management		3	3	0	0	3
6	ELCC 331	Computer Aided Design		2	0	4	0	4
Total				18	13	10	2	25

CRH:Credit Hours **L**:Lecture **P**:Practical **T**:Tutorial **CTH**:Contact Hours

Seventh Semester

No.	Course Code	Course Name	Pre. Req	No. of Units				
				CRH	L	P	T	CTH
1	MATH 302	Mathematics (2)	MATH301	3	2	2	0	4
2	ELCC 342	Analog and pulses Circuits	ELCC 333	3	2	2	0	4
3	ELCC 321	Signals and systems	MATH 301	3	3	0	0	3
4	ELCC322	Sensors and actuators	PHY 301	3	2	2	0	4
5	ELCC 328	Digital Systems Design		4	3	2	0	5
6	ELCC 432	Industrial Process Control	ELCC 331	3	2	2	0	4
Total				19	14	10	0	24

CRH:Credit Hours **L**:Lecture **P**:Practical **T**:Tutorial **CTH**:Contact Hours

Eighth Semester								
No.	Course Code	Course Name	Pre. Req	No. of Units				
				CRH	L	P	T	CTH
1	STAT 303	Statistics and Probability		3	3	0	1	4
2	ENGL302	English Language (2)	ENGL301	3	3	0	1	4
3	GNRL 405	Engineering Economy		2	2	0	0	2
4	ELCC452	Power Electronics	ELCC342	4	3	2	1	6
5	ELCC 329	Embedded Systems	ELCC328	3	2	2	1	5
6	ELCC427	Electromechanical Systems	ELCC333	2	2	0	1	3
Total				17	15	4	5	24

CRH:Credit Hours **L**:Lecture **P**:Practical **T**:Tutorial **CTH**:Contact Hours

Ninth Semester								
No.	Course Code	Course Name	Pre. Req	No. of Units				
				CRH	L	P	T	CTH
1	ELCC 434	Electric Drives	ELCC452	3	2	2	1	5
2	ELCC 464	Robotics	ELCC 322	3	2	2	1	5
3	ELCC 437	Digital Control System	ELCC 432	3	2	2	1	5
4	ELCC ***	Elective 1		4	3	2	1	6
5	ELCC 411	Renewable Energy Technologies	ELCC 342	2	2	0	1	3
Total				15	11	8	5	24

CRH:Credit Hours **L**:Lecture **P**:Practical **T**:Tutorial **CTH**:Contact Hours

Tenth Semester								
No.	Course Code	Course Name	Pre. Req	No. of Units				
				CRH	L	P	T	CTH
1	ELCC 491	Graduation Project	ELCC 452 ELCC 329	4	2	4	0	6
2	ELCC 473	Digital Communication Systems	ELCC 328	3	2	2	1	5
3	ELCC 442	Integrated VLSI Circuit Design	ELCC329	2	2	0	0	2
4	ELCC ***	Elective 2		3	2	2	1	5
Total				12	8	08	2	18

CRH:Credit Hours **L**:Lecture **P**:Practical **T**:Tutorial **CTH**:Contact Hours

Total Number of Semesters Credit Units	CRH	L	P	T	CTH
	81	61	40	14	115
Total of training Hours 16 * 115	1840				

Elective Courses

Elective Course 1

No.	Course Code	Course Name	Pre. req	No. of Units				
				CRH	L	P	T	CTH
1	ELCC 435	Programmable Logic Controller PLC	ELCC 328	4	3	2	1	6
2	ELCC 428	Mechatronics	ELCC 322	4	3	2	1	6
3	ELCC 474	Artificial Intelligence	ELCC 331	4	3	2	1	6

CRH:Credit Hours **L**:Lecture **P**:Practical **T**:Tutorial **CTH**:Contact Hours

Elective Course 2

No.	Course Code	Course Name	Pre. req	No. of Units				
				CRH	L	P	T	CTH
1	ELCC 412	Supervision of Industrial Processes	ELCC 435	3	2	2	1	5
2	ELCC 436	Industrial Robotics	ELCC 474	3	2	2	1	5
3	ELCC 463	Electric vehicles	ELCC 428	3	2	2	1	5

CRH:Credit Hours **L**:Lecture **P**:Practical **T**:Tutorial **CTH**:Contact Hours

Courses Detail Description

<table>
<tr><td>Department</td><td>Electronics Engineering</td><td>Major</td><td colspan="6">Industrial Electronics & Control</td></tr>
<tr><td>Course Name</td><td>Circuit Analysis</td><td>Course Code</td><td colspan="6">ELCC333</td></tr>
<tr><td rowspan="2">Prerequisites</td><td rowspan="2"></td><td rowspan="2">Credit Hours
CRH</td><td colspan="2">4</td><td colspan="2">CTH</td><td colspan="2">6</td></tr>
<tr><td>L</td><td>3</td><td>P</td><td>2</td><td>T</td><td>1</td></tr>
<tr><td colspan="9">CRH: Credit Hours L: Lecture P: Practical T: Tutorial CTH: Contact Hours</td></tr>
</table>

Course Description :

The goals for this course are to provide the student with an understanding of, and a proficiency in the analysis of:

Topics :

- Different types of power and power factor correction.
- Balanced/unbalanced, three-phase circuits, considering the power generation and distribution.
- Magnetically coupled circuits and their application in electric transformers.
- Transient and steady state behavior of RL RC and RLC circuits.
- Different types of filters and the series/parallel resonance circuits.
- Frequency response of a circuit using the s-plane representation and analysis, Bode Plots and computer-aided methods.
- Different representations and parameters of two-port networks, e.g. Z-parameters, Y-parameters, h-parameters and g-parameters.

Experiments: If applicable, it will support the course topics.

References :

- Charles K. Alexander and Matthew N. O. Sadiku, Fundamentals of Electric Circuits. Fifth Edition. McGraw-Hill.
- Thomas L.Floyed and David M Buchla, Electronics fundamentals circuits, devices, and application , 8th edition Pearson

Detailed of Theoretical Contents		
No.	Contents	Hours
1	Introduction (general background).	2
2	Balanced Three-Phase Voltages and Currents Balanced Wye-Wye and balanced Wye-Delta Circuits.	6
3	Balanced Delta-Delta and Delta-Wye Circuits, power in Balanced 3-Phase Circuits and power factor correction of 3-phase circuits	6
4	Unbalanced Three-Phase Y-Y, 3-wire & 4-wire Circuits, unbalanced 3-Ph Δ-Δ Circuits with & without T.L. impedance and unbalanced Three-Phase Y- Δ and Δ-Y Circuits.	6
5	Self and Mutual Inductance, energy in coupled coils, ideal transformers and Autotransformers.	6
6	Transfer Function, Bode Plots	6

7	Series and parallel resonance	**6**
8	Passive Filters (Low-pass, High-pass, Band-pass, Band-Reject)	**6**
9	Standard inputs (step – ramp – impulse), source-free RC Circuits and source-free RL Circuits. Step Response of RC, RL	**6**
10	Step Response RLC series Circuits and RLC parallel circuit.	**6**
11	Impedance Z-Parameters, admittance Y-parameters, Hybrid H-Parameters, Inverse Hybrid G-Parameters, Transmission (T) Parameters, Inverse T parameters, Series and parallel connection of networks.	**6**
12	Final Assessment.	**2**
Textbook	• Charles K. Alexander and Matthew N. O. Sadiku, Fundamentals of Electric Circuits. 5th Edition. McGraw-Hill • Thomas L.Floyed and David M Buchla, Electronics fudamentals circuits, devices, and application, 8th edition Pearson.	

Detailed of Practical Contents		
No.	**Contents**	**Hours**
1.	Power measurement in balanced 3-phase system	**4**
2.	Power measurement in unbalanced 3-phase system	**4**
3.	Power factor compensation in single phase system	**4**
4.	Power factor compensation in 3-phase system	**2**
5.	Single phase and three phase Transformer and Auto-transformer	**6**
6.	Series and parallel resonance	**4**
7.	Passive filter First order circuits (RC, RL, CR, LR)	**4**
8.	Second order circuits (RLC)	**2**
9.	Final Assessment.	**2**
Textbook		

Textbooks	• Charles K. Alexander and Matthew N. O. Sadiku, Fundamentals of Electric Circuits. 5th Edition. McGraw-Hill
	• Thomas L.Floyed and David M Buchla, Electronics fundamentals circuits, devices, and application , 8th edition Pearson

<table>
<tr><td>Department</td><td>Electronics Engineering</td><td>Major</td><td colspan="6">Industrial Electronics & Control</td></tr>
<tr><td>Course Name</td><td>Computer Aided Design</td><td>Course Code</td><td colspan="6">ELCC 331</td></tr>
<tr><td rowspan="2">Prerequisites</td><td rowspan="2"></td><td rowspan="2">Credit Hours CRH</td><td colspan="2">2</td><td colspan="2">CTH</td><td colspan="2">4</td></tr>
<tr><td>L</td><td></td><td>P</td><td>4</td><td>T</td><td></td></tr>
<tr><td colspan="9">CRH: Credit Hours L: Lecture P: Practical T: Tutorial CTH: Contact Hours</td></tr>
</table>

Course description :

This course gives the trainees the fundamentals of the computer aided design for electronic circuits. Trainees will use Matlab software, one of the most popular computer aided design programs for engineering. Special emphasis is placed on the Overview of Matlab Simulink. The toolbox, Graphics Mode, Editing a new design, Placement, Edit the characteristics of a component, Adding a generator, Edition of the characteristics of the generator, Simulation, The measuring instruments, Preparation routing.

Topics :

- Introduction to System Simulation Techniques and Applications
- Fundamentals of MATLAB Programming
- MATLAB Applications in Scientific Computation
- Mathematical Modeling and Simulation with Simulink
- Commonly Used Blocks and Intermediate-level Modeling Skills
- Advanced Techniques in Simulink Modeling and Applications
- Modeling and Simulation of Engineering Systems
- Modeling and Simulation of Non-Engineering Systems

References :

Dingyu Xue, Yang Quan Chen, System simulation techniques with Matlab and Simulink, 2014 John Wiley & Sons, Ltd

Detailed of Practical Contents		
No.	**Contents**	**Hours**
1	Introduction to System Simulation Techniques and Applications Overview of System Simulation Techniques m Development of Simulation Software, development of Earlier Mathematics Packages, Development of Simulation Software and Languages	**8**
2	Fundamentals of MATLAB Programming MATLAB Environment, Data Types in MATLAB, Matrix Computations in MATLAB, Flow Structures, Programming and Tactics of MATLAB Functions, Two-dimensional Graphics in MATLAB, Three-dimensional Graphics, Graphical User Interface Design in MATLAB	**8**
3	MATLAB Applications in Scientific Computation Analytical and Numerical Solutions, Solutions to Linear Algebra Problems, Solutions of Calculus Problems, Solutions of Ordinary Differential Equations, Nonlinear Equation Solutions and Optimization, Dynamic Programming and its Applications in	**8**

	Path Planning	
4	Mathematical Modeling and Simulation with Simulink Description of the Simulink Block Library, Simulink Modeling, Model Manipulation and Simulation Analysis, Illustrative Examples of Simulink Modeling, Modeling, Simulation and Analysis of Linear Systems, Simulation of Continuous Nonlinear Stochastic Systems	**8**
5	Commonly Used Blocks and Intermediate-level Modeling Skills Commonly Used Blocks and Modeling Skills, Modeling and Simulation of Multivariable Linear Systems, Nonlinear Components with Lookup Table Blocks, Block Diagram Based Solutions of Differential Equations, Output Block Library, Subsystems and Block Masking Techniques	**8**
6	Advanced Techniques in Simulink Modeling and Applications Command-line Modeling in Simulink, System Simulation and Linearization, S-function Programming and Applications, Examples of Optimization in Simulation: Optimal Controller Design Applications	**8**
7	Modeling and Simulation of Engineering Systems Physical System Modeling with Simscape, Description of SimPowerSystems, Modeling and Simulation of Electronic Systems, Simulation of Motors and Electric Drive Systems	**8**
8	Modeling and Simulation of Non-Engineering Systems Modeling and Simulation of Pharmacokinetics Systems, Video and Image Processing Systems, Finite State Machine Simulation and Stateflow Applications, Simulation of Discrete Event Systems with SimEvents	**6**
9.	Final Assessment.	**2**

Textbook:	Dingyu Xue, Yang Quan Chen, System simulation techniques with Matlab and Simulink, 2014 John Wiley & Sons, Ltd

Department	Electronics Engineering	Major	Industrial Electronics & Control					
Course Name	Analog and pulses Circuits	Course Code	ELCC341					
Prerequisites	ELCC 333	Credit Hours CRH	3		CTH		4	
			L	2	P	2	T	0

CRH: **Credit Hours** L: **Lecture** P: **Practical** T: **Tutorial** CTH: **Contact Hours**

Course Description :

The course introduces analog electronics, with little mathematical or physical analysis and much opportunity to design and build circuits. The treatment moves quickly from fundamentals (for example, passive circuits made with resistors, capacitors) to designs with transistors and then gives most of its attention to the design of circuits using operational amplifiers: circuits such as integrators, amplifiers, oscillators, filters, and a servo loop.

Topics :

- Operational Amplifiers
- Operational Amplifiers Applications
- Power Amplifiers
- Linear-Digital ICs
- Feedback and Oscillator Circuits
- Power Supplies (Voltage regulators)
- Other Two-Terminal Devices
- pnpn and Other Devices
- Oscilloscope and Other Measuring Instruments

Experiments: If applicable, it will support the course topics

References :

- Kleitz, Digital Electronics: Pearson New International Edition: A Practical Approach with VHDL, Pearson; 9 edition (20 Sept. 2013).
- Boylestad and Nashelsky, Electronic Devices and Circuit Theory, 6th edition, Prentice Hall,1996
- Savant, Roden and Carpenter, Electronic Design, 2nd edition, Addison-Wesley, 1991
- Thomas L.Floyed and David M Buchla, Electronics fundamentals circuits, devices, and application, 8th edition Pearson.

Detailed of Theoretical Contents		
No.	**Contents**	**Hours**
1	Introduction (general background).	**2**
2	Operational Amplifiers	**4**
3	Operational Amplifiers Applications	**4**
4	Power Amplifiers	**4**
5	Linear-Digital ICs	**4**
6	Feedback and Oscillator Circuits	**2**
7	Power Supplies (Voltage regulators)	**2**
8	Other Two-Terminal Devices	**2**
9	p-n-p-n and Other Devices	**2**
10	Oscilloscope and Other Measuring Instruments	**4**
11	Final Assessment.	**2**

Textbook	• Kleitz, Digital Electronics: Pearson New International Edition: A Practical Approach with VHDL, Pearson; 9 edition (20 Sept. 2013). • Boylestad and Nashelsky, Electronic Devices and Circuit Theory, 6th edition, Prentice Hall,1996.

Detailed of Practical Contents		Hours
No.	**Contents**	**Hours**
1.	Introduction of Electronics	**2**
2.	Operational amplifier (op amp) circuits:	**2**
3.	Op Amp I – Terminal voltages	**2**
4.	Op Amp II – Terminal currents	**2**
5.	Op Amp III – Voltage follower	**2**
6.	Op Amp IV – Inverting and no inverting amplifiers	**2**
7.	Single-Stage Integrated-Circuit Amplifiers	**2**
8.	Differential and Multistage Amplifiers	**2**
9.	Operational-Amplifier and Data-Converter Circuits	**2**
10.	Filters and Tuned Amplifiers	**2**
11.	Digital CMOS Logic Circuits	**2**
12.	Memory and Advanced Digital Circuits	**2**
13.	Signal Generators and Waveform-Shaping Circuits	**2**
14.	555 Timer	**4**
15.	Final Assessment	**2**

Textbook	• Boylestad and Nashelsky, Electronic Devices and Circuit Theory, 6th edition,Prentice Hall,1996. • Kleitz, Digital Electronics: Pearson New International Edition: A Practical Approach with VHDL, Pearson; 9 edition (20 Sept. 2013). Recommended Software: Electronic Workbench.

Textbooks	• Boylestad and Nashelsky, Electronic Devices and Circuit Theory, 6th edition,Prentice Hall,1996.
	• Kleitz, Digital Electronics: Pearson New International Edition: A Practical Approach with VHDL, Pearson; 9 edition (20 Sept. 2013). • Recommended Software: Electronic Workbench.

Department	Electronics Engineering	Major	Industrial Electronics & Control					
Course Name	Signals and systems	Course Code	ELCC321					
Prerequisites	MATH 301	Credit Hours CRH	3		CTH		3	
			L	3	P	0	T	0

CRH: **Credit Hours** L: **Lecture** P: **Practical** T: **Tutorial** CTH: **Contact Hours**

Course Description :

The objectives of this course are to introduce students to the basic concepts of signals, system modeling, and system classification; to develop students' understanding of time-domain and frequency domain approaches to the analysis of continuous and discrete systems; to provide students with necessary tools and techniques to analyze electrical networks and systems; and to develop students' ability to apply modern simulation software to system analysis.

Topics :

- Introduction to signals and systems
- Linear time-invariant systems.
- Fourier Series
- Fourier Transform
- Time and frequency characterization of signal and systems
- Sampling
- Communication systems
- The Laplace Transform
- The Z-Transform
- Linear Feedback systems

Experiments: If applicable, it will support the course topics

References :

- Openheim and Wilsky, Signals and Systems, Prentice Hall, 1992
- Frederick and Carlson, Linear Systems, Prentice Hall.

Detailed of Theoretical Contents		
No.	**Contents**	**Hours**
1	Introduction to signals and systems	2
2	Linear time-invariant systems	3
3	Fourier Series	6
4	Fourier Transform	6
5	Time and frequency characterization of signal and systems	6
6	Sampling	3
7	Communication systems	6
8	The Laplace Transform	4
9	The Z-Transform	4

10	Linear Feedback systems	**6**
11	Final Assessment	**2**

Textbook	• Shaila Dinkar Apte, Signals and Systems: Principles and Applications, Cambridge University Press, 2016 • Openheim and Wilsky, Signals and Systems, Prentice Hall, 1992.

Textbooks	• Shaila Dinkar Apte, Signals and Systems: Principles and Applications, Cambridge University Press, 2016 • Openheim and Wilsky, Signals and Systems, Prentice Hall, 1992.

<table>
<tr><td>Department</td><td>Electronics Engineering</td><td>Major</td><td colspan="6">Industrial Electronics & Control</td></tr>
<tr><td>Course Name</td><td>Sensors and Actuators</td><td>Course Code</td><td colspan="6">ELCC322</td></tr>
<tr><td rowspan="2">Prerequisites</td><td rowspan="2">PHY 301</td><td rowspan="2">Credit Hours
CRH</td><td colspan="2">3</td><td colspan="2">CTH</td><td colspan="2">4</td></tr>
<tr><td>L</td><td>2</td><td>P</td><td>2</td><td>T</td><td>0</td></tr>
<tr><td colspan="9">CRH: Credit Hours L: Lecture P: Practical T: Tutorial CTH: Contact Hours</td></tr>
</table>

Course Description :

Introduction to physics, principles, and operating mechanisms of various kinds of sensors. Using sensors in designing and developing for different applications. Sensor technology, resistive, capacitive, inductive and magnetic transducers, basic sensor structures for each type, sensing effects, physical sensors and their applications. Dynamic range, linearity, threshold, accuracy, operational environmental condition strain gauge, thermocouple, RTD, photo sensors for measuring chemical quantities. Light sensors, flow and speed sensors, radioactive sensor. Introduction to digital sensors. Actuators and their role in automatic control, pulse width modulation technique for power control. Examples in temperature, speed and light control systems.

Topics :

- Sensors and actuators: Definitions, terminology, classification
- Sensors characteristics and parameters.
- Thermal sensors.
- Mechanical sensors.
- Pressure sensors
- Optical sensors and Optical Fiber.
- Chemical and physical sensors for gas and liquid media.
- Gas sensors
- Biosensors, RTD
- Nano-sensors.
- Capacitive and resistive sensors, Magnetic sensors, Hall-effect sensors, piezoelectric transducers, Optical sensors-air path, Fibre-optic sensors, Ultrasonic sensors
- Temperature Measurement: Thermoelectric effect sensors, Quartz thermometers, intelligent temperature-measuring instruments, Acoustic thermometers
- Wheatstone bridge and Instrumentation Amplifier.

Experiments: If applicable, it will support the course topics

References :

- Nathan Ida , Sensors, Actuators, and Their Interfaces: A Multidisciplinary Introduction, SciTech Publishing, Year: 2014
- Andrzej M. Pawlak, "Sensors and Actuators in Mechatronics: Design and Applications", CRC Press – Taylor & Francis Group, Last Edition, 2006.

Detailed of Theoretical Contents		
No.	**Contents**	**Hours**
1	Introduction to sensors and actuators	1
2	Sensors and measurement: Definitions, terminology, classification	2

3	Sensors characteristics and parameters	**2**
4	Thermal sensors.	**2**
5	Mechanical sensors.	**2**
6	Pressure sensors	**2**
7	Optical sensors and Optical Fiber	**2**
8	Chemical and physical sensors for gas and liquid media.	**2**
9	Gas sensors	**2**
10	RTD	**2**
11	Biosensors	**2**
12	Nano-sensors	**2**
13	Wheatstone Bridge and Instrumentation Amplifier	**2**
14	Capacitive and resistive sensors, Magnetic sensors, Hall-effect sensors, Piezoelectric transducers, Optical sensors-air path, Fibre-optic sensors, Ultrasonic sensors	**2**
15	Temperature Measurement: Thermoelectric effect sensors, Quartz thermometers, Intelligent temperature-measuring instruments, Acoustic thermometers	**3**
16	Final assessment	**2**

Textbook	• Nathan Ida , Sensors, Actuators, and Their Interfaces: A Multidisciplinary Introduction, SciTech Publishing, Year: 2014 • Andrzej M. Pawlak, "Sensors and Actuators in Mechatronics: Design and Applications", CRC Press – Taylor & Francis Group, Last Edition, 2006.

Detailed of Practical Contents		
No.	**Contents**	**Hours**
1.	Introduction.	**2**
2.	Thermistor (NTC).	**2**
3.	Resistance Temperature Detector (RTD).	**2**
4.	Thermocouple.	**2**
5.	Length sensor.	**2**
6.	Linear variable differential transformer (LVDT).	**2**
7.	Strain Gauge.	**2**
8.	Pressure sensor (piezoresistive).	**2**
9.	Ultrasound sensor (Doppler effect).	**4**
10.	Gas sensors.	**2**
11.	Biosensors	**2**
12.	Nano-sensors	**2**
13.	Wheatstone Bridge and Instrumentation Amplifier1	**2**
14.	Wheatstone Bridge and Instrumentation Amplifier2	**2**
15.	Final assessment	**2**
Textbook	• John P. Bentley, principles of measurement systems, 4th edition. • J. Fraden, "Handbook of Modern Sensors" (AIP) Third Edition.	

Textbooks	• Nathan Ida , Sensors, Actuators, and Their Interfaces: A Multidisciplinary Introduction, SciTech Publishing, Year: 2014 • Andrzej M. Pawlak, "Sensors and Actuators in Mechatronics: Design and Applications", CRC Press – Taylor & Francis Group, Last Edition, 2006.
	• John P. Bentley, principles of measurement systems, 4th edition. • J. Fraden, "Handbook of Modern Sensors" (AIP) Third Edition.

<table>
<tr><td>Department</td><td>Electronics Engineering</td><td>Major</td><td colspan="6">Industrial Electronics & Control</td></tr>
<tr><td>Course Name</td><td>Digital Systems Design</td><td>Course Code</td><td colspan="6">ELCC 328</td></tr>
<tr><td rowspan="2">Prerequisites</td><td rowspan="2"></td><td rowspan="2">Credit Hours
CRH</td><td colspan="2">4</td><td colspan="2">CTH</td><td colspan="2">5</td></tr>
<tr><td>L</td><td>3</td><td>P</td><td>2</td><td>T</td><td>0</td></tr>
<tr><td colspan="9">CRH: Credit Hours L: Lecture P: Practical T: Tutorial CTH: Contact Hours</td></tr>
</table>

Course Description :

This course gives trainees the fundamentals of the digital systems. Their different architectures and their use within electronic system design. Digital Logic Design with VHDL as well as Digital Signal Processing DSP will be studied. Interfacing Digital Logic to the Real World (A/D Conversion, D/A Conversion) will be emphasis.

Topics :

- Introduction to Programmable Logic
- Electronic Systems Design
- PCB Design
- Design Languages
- Digital Logic Design
- Digital Logic Design with VHDL
- Interfacing Digital Logic to the Real World
- Testing the Electronic System
- System-Level Design

Experiments: If applicable, it will support the course topics

References :

- Charles H. Roth, Jr. and Lizy Kurian J., Digital Systems Design Using VHDL, , 2ndEdition, Thomson Learning ISBN : ISBN: 10: 0-534-38462-5 ISBN: 13: 978-0-534-38462-3
- Ian Grout, Digital Systems Design with FPGAs and CPLDs, 2008, Elsevier Ltd. ISBN-13: 978-0-7506-8397-5
- K. C. Chang, Digital Systems Design With VHDL And Synthesis: An Integrated Approach, May 1999, Wiley-IEEE Computer Society Press, ISBN: 978-0-7695-0023-2

Detailed of Theoretical Contents		
No.	**Contents**	**Hours**
1	**Review of Logic Design Fundamentals** Combinational Logic, Boolean Algebra and Algebraic Simplification, Karnaugh Maps, Designing with NAND and NOR Gates, Flip-Flops and Latches, Mealy Sequential Circuit Design, Moore Sequential Circuit Design, Equivalent States and Reduction of State Tables, Sequential Circuit Timing, Tristate Logic and Busses	4
2	**Introduction to VHDL** Computer-Aided Design, Hardware Description Languages, VHDL Description of Combinational Circuits, VHDL Modules, Sequential Statements and VHDL Processes, Modeling Flip-Flops Using VHDL Processes, Processes Using Wait Statements, Two Types of VHDL Delays: Transport and Inertial Delays, Compilation, Simulation, and Synthesis of VHDL Code, VHDL Data Types and Operators, Simple Synthesis Examples, VHDL Models for Multiplexers, VHDL Libraries, Modeling Registers and Counters Using VHDL Processes, Behavioral and Structural VHDL, Variables, Signals, and Constants , Arrays, Loops in VHDL	4
3	**Programmable Logic Devices** Brief Overview of Programmable Logic Devices, Simple Programmable Logic Devices	5

	(SPLDs); Complex Programmable Logic Devices (CPLDs), Field-Programmable Gate Arrays (FPGAs)	
4	**Design Examples** BCD to 7-Segment Display Decoder, A BCD Adder, Bit Adders, Traffic Light Controller, State Graphs for Control Circuits, Scoreboard and Controller, Synchronization and Debouncing, A Shift-and-Add Multiplier, Array Multiplier, A Signed Integer/Fraction Multiplier, Keypad Scanner, Binary Dividers	5
5	**SM Charts and Microprogramming** State Machine Charts, Derivation of SM Charts, Realization of SM Charts, Implementation of the Dice Game, Microprogramming, Linked State Machines	5
6	**Designing with Field Programmable Gate Arrays** Implementing Functions in FPGAs, Implementing Functions Using Shannon's Decomposition, Array Chains in FPGAs, Cascade Chains in FPGAs, Examples of Logic Blocks in Commercial FPGAs, Dedicated Memory in FPGAs, Dedicated Multipliers in FPGAs, Cost of Programmability, FPGAs and One-Hot State Assignment, FPGA Capacity: Maximum Gates Versus Usable Gates, Design Translation (Synthesis), Mapping, Placement, and Routing	5
7	**Floating-Point Arithmetic** Representation of Floating-Point Numbers, Floating-Point Multiplication, Floating-Point Addition, Other Floating-Point Operations	6
8	**Additional Topics in VHDL** VHDL Functions, VHDL Procedures, Attributes, Creating Overloaded Operators, Multi-Valued Logic and Signal Resolution, The IEEE 9-Valued Logic System, SRAM Model Using IEEE 1164, Model for SRAM Read/Write System 410, Generics 413, Named Association 414, Generate Statements 415, Files and TEXTIO	6
9	**Hardware Testing and Design for Testability** Testing Combinational Logic 468, Testing Sequential Logic 473, Scan Testing 476, Boundary Scan 479, Built-In Self-Test	6
10	Final Assessment.	2

Textbook	• Ian Grout, Digital Systems Design with FPGAs and CPLDs, 2008, Elsevier Ltd. ISBN-13: 978-0-7506-8397-5 • Harles H. Roth, Jr. and Lizy Kurian J., Digital Systems Design Using VHDL, , 2nd Edition, Thomson Learning ISBN : ISBN: 10: 0-534-38462-5 ISBN: 13: 978-0-534-38462-3

Detailed of Practical Contents		
No.	**Contents**	**Hours**
1.	Introduction and VHDL Basics	4
2.	Combinational Logic	4
3.	The Process Statement	2
4.	Sequential Logic	4
5.	State Machines	2
6.	Miscellaneous topics with VHDL	4
7.	Test benches with VHDL	4
8.	Advanced Testing with VHDL	4
9.	VHDL for Modeling	2
10.	Final Assessment.	2

Textbook	• Pong P. Chu, FPGA Prototyping by Verilog examples Xilinx SpartanTM-3 ,2008 Wiley, ISBN 978-0-470-18532-2 • Douglas L. Perry, VHDL: Programming by Example, 2002, 4th Edition McGraw-Hill, DOI: 10.1036/0071409548

Textbooks	• Ian Grout, Digital Systems Design with FPGAs and CPLDs, 2008, Elsevier Ltd. ISBN-13: 978-0-7506-8397-5 • Harles H. Roth, Jr. and Lizy Kurian J., Digital Systems Design Using VHDL, , 2nd Edition, Thomson Learning ISBN : ISBN: 10: 0-534-38462-5 ISBN: 13: 978-0-534-38462-3
	• Pong P. Chu, FPGA Prototyping by Verilog examples Xilinx SpartanTM-3 ,2008 Wiley, ISBN 978-0-470-18532-2 • Douglas L. Perry, VHDL: Programming by Example, 2002, 4th Edition McGraw-Hill, DOI: 10.1036/0071409548

<table>
<tr><td rowspan="2">Department</td><td rowspan="2">Electronics Engineering</td><td rowspan="2">Major</td><td colspan="6">Industrial Electronics & Control</td></tr>
<tr></tr>
<tr><td>Course Name</td><td>Industrial Process Control</td><td>Course Code</td><td colspan="6">ELCC 432</td></tr>
<tr><td rowspan="2">Prerequisites</td><td rowspan="2">ELCC 331</td><td rowspan="2">Credit Hours
CRH</td><td colspan="3">3</td><td colspan="2">CTH</td><td>4</td></tr>
<tr><td>L</td><td>2</td><td>P</td><td>2</td><td>T</td><td>0</td></tr>
<tr><td colspan="9">CRH: Credit Hours L: Lecture P: Practical T: Tutorial CTH: Contact Hours</td></tr>
</table>

Course Description :
The objective of this course is to teach the student how to derive a mathematical model of a physical system, evaluate process performance, and improve performance by appropriate feedback control schemes. After this course, students are expected to know how to analyze the performance of control systems and design feedback controllers to meet the required performance system specifications.

Topics :

- Introduction to Process Control and feedback Control
- Laplace Transformation: Properties of Laplace transform, Inverse of Laplace transform
- Solving Differential equations using Laplace transform
- Mathematical Modeling of Process Control (Level Tank of first Order)
- Dynamic Response of First Order Process, Linearization of Nonlinear First order Process
- Dynamic Behavior of Second-Order Process
- Multicapacity Processes as Second Order Processes (Noninteracting)
- Multicapacity Processes as Second Order Processes (Interacting)
- Industrial Controller (On/Off – Proportional Mode), (Integral-Derivative Mode)
- Final Control Elements (Control Valves)
- Measuring Elements (transducers)
- Dynamic behavior of Feedback Controlled Process
- Closed-loop responses of simple Control system (Proportional-Integral-Derivative Controller)
- Stability of Closed-Loop Control Systems (Routh Criterion)
- Process Reaction Tuning, Application of Process Reaction Tuning
- Introduction to State-Space
- Controlability, Observability
- Advanced Forms of PID Algorithms, Simulating Noise and Process Disturbances
- Filter Action and Filter Time Constant
- Estimating Correct Filter Time Constant in DCS or PLC

Experiments: If applicable, it will support the course topics

References :

- Steven E LeBlanc; Donald R Coughanowr, Process systems analysis and control, McGraw-Hill Higher Education, 2009
- P.C. Chau, Process Control: A First Course with MATLAB, Cambridge Publishers (2002).

Detailed of Theoretical Contents		
No.	**Contents**	**Hours**
1	Introduction	**1**
2	**Introduction to Process Control and feedback Control**: History of Automatic Control, Two Examples of the Use of Feedback, Control Engineering Practice,	**3**

	Examples of Modern Control Systems, Automatic Assembly and Robots, The Future Evolution of Control Systems. Laplace Transformation: Introduction to the Laplace Method, Laplace Integral Table, Laplace Transform Rules	
3	**Properties of Laplace transform**: Heaviside's Method, Partial Fraction Theory, Heaviside's Coverup Method, Heaviside Step and Dirac Delta. Inverse of Laplace transform: The Laplace Transformation, The Linearity Property of the Laplace Transformation, Inverting using completion of the square.	**2**
4	**Solving Differential equations using Laplace transform**: Introduction and Background Information, Properties of the Laplace Transform, Inverse Laplace Transform, Solving a Differential Equation using Laplace (Level Tank of first Order)	**4**
5	**Dynamic Response of First Order Process**: First-Order Linear System Transient Response, The Homogeneous Response and the First-Order Time Constant, The Characteristic Response of First-Order System Linearization of Nonlinear First Order Process	**2**
6	**Dynamic Behavior of Second-Order Process**: for a stochastic target problem, Multicapacity Processes as Second Order Processes (Noninteracting): First-Order Linear System Transient Response, The Homogeneous Response and the First-Order Time Constant, The Characteristic Response of First-Order Systems.	**2**
7	**Multicapacity Processes as Second Order Processes** (Interacting) Industrial Controller (On/Off – Proportional Mode): Continuous Process Control, Closed-Loop Control.	**2**
8	**Industrial Controller** (Integral-Derivative Mode), Proportional Integral Derivative Control, Real-time Control and Data LoggingFinal Control Elements (Control Valves): The Final Control Element, Electric Motor, Relay, Pneumatic actuator	**2**
9	**Dynamic behavior of Feedback Controlled Process**	**2**
10	**Closed-loop responses of simple Control system**	**2**
11	**Closed-loop responses of simple Control system** (Proportional-Integral-Derivative Controller): Programming PID Algorithm, Proportional VI, Integral VI, Derivative VI.	**2**
12	**Process Reaction Tuning**: Good Gain method, Ziegler-Nichols' closed loop method, The Ziegler-Nichols' PID tuning procedure,	**2**
13	**Introduction to State-Space**: The State Space Model and Differential Equations, State Space Variables from Transfer Functions.	**2**
14	**Controllability, observability**: Observability of Discrete Systems, Observability of Continuous Systems, Controllability of Discrete Systems, Controllability of Continuous Systems, Additional Controllability/Observability Topics	**2**
15	Final assessment	**2**

Textbook	• Steven E LeBlanc; Donald R Coughanowr, Process systems analysis and control, McGraw-Hill Higher Education, 2009 • P.C. Chau, Process Control: A First Course With MATLAB, Cambridge Publishers (2002).

Detailed of Practical Contents		
No.	**Contents**	**Hours**
1.	Introduction	**2**
2.	Manual Control valve	**2**
3.	Solenoid Valves	**4**
4.	Motorized control Valve	**2**
5.	On / Off Level Control Using electrodes	**2**
6.	Manual Input calibration	**2**

7.	Process Controller Calibration	**4**
8.	On / Off Process Controller	**2**
9.	P-Controller	**2**
10.	PI-Controller	**2**
11.	PD-Controller	**2**
12.	PID-Controller	**2**
13.	Auto tuning of PID-Controller	**2**
14.	Final assessment	**2**
Textbook	• Cheng Siong Chin, COMPUTER AIDED CONTROL SYSTEMS DESIGN, Practical Applications Using MATLAB® and Simulink, 2013 by Taylor & Francis Group, LLC.	

Textbooks	• Steven E LeBlanc; Donald R Coughanowr, Process systems analysis and control, McGraw-Hill Higher Education, 2009 • P.C. Chau, Process Control: A First Course With MATLAB, Cambridge Publishers (2002).
	• Cheng Siong Chin, COMPUTER AIDED CONTROL SYSTEMS DESIGN, Practical Applications Using MATLAB® and Simulink, 2013 by Taylor & Francis Group, LLC.

<table>
<tr><td>Department</td><td>Electronics Engineering</td><td>Major</td><td colspan="6">Industrial Electronics & Control</td></tr>
<tr><td>Course Name</td><td>Power Electronics</td><td>Course Code</td><td colspan="6">ELCC 452</td></tr>
<tr><td rowspan="2">Prerequisites</td><td rowspan="2">ELCC 342</td><td rowspan="2">Credit Hours
CRH</td><td colspan="2">4</td><td colspan="2">CTH</td><td colspan="2">6</td></tr>
<tr><td>L</td><td>3</td><td>P</td><td>2</td><td>T</td><td>1</td></tr>
<tr><td colspan="9">CRH: Credit Hours L: Lecture P: Practical T: Tutorial CTH: Contact Hours</td></tr>
</table>

Course Description :
This course examines the application of electronics to energy conversion and control. Topics covered include: modeling, analysis, and control techniques; design of power circuits including inverters, rectifiers, AC-AC and DC-DC converters; analysis and design of magnetic components and characteristics of power semiconductor devices. Numerous application examples will be presented such as Aerospace, Railway, Electrical Automotive, Solar, Lighting, Power supplies, both theoretical and practical laboratory simulations.

Topics :

- Converter classification and electronic switches.
- Power computations.
- Half-wave rectifiers: the basics of analysis
- Full-wave and 3-phase rectifiers converting AC to DC
- AC to AC converters
- DC to DC converters
- DC power supplies
- Inverters: Converters AC to DC
- Resonant converters

Experiments: If applicable, it will support the course topics

References :

- Rashid, Muhammad H; Power Electronics Handbook - Devices, Circuits, and Applications, Elsevier, 2011
- Moorthi, V. R, Power electronics : devices, circuits and industrial applications, Oxford University Press, 2010

Detailed of Theoretical Contents		
No.	**Contents**	**Hours**
1	Converter classification and electronic switches.	**4**
2	Power computations.	**8**
3	Half-wave rectifiers: the basics of analysis	**8**
4	Full-wave and 3-phase rectifiers converting AC to DC	**6**

5	AC to AC converters	**6**
6	DC to DC converters	**8**
7	DC power supplies	**8**
8	Inverters: Converters AC to DC	**8**
9	Resonant converters	**6**
10	Final Assessment.	**2**
Textbook	• Rashid, Muhammad H; Power Electronics Handbook - Devices, Circuits, and Applications, Elsevier, 2011 • Moorthi, V. R, Power electronics : devices, circuits and industrial applications, Oxford University Press, 2010	

Detailed of Practical Contents		
No.	**Contents**	**Hours**
1.	Uncontrolled AC/DC converters	**4**
2.	Controlled AC/DC converters and DC motor drive	**6**
3.	AC/AC converters	**4**
4.	DC/DC converters	**6**
5.	DC/AC converters and AC motor drive	**8**
6.	Final Assessment.	**4**
Textbook	• Rashid, Muhammad H; Power Electronics Handbook - Devices, Circuits, and Applications, Elsevier, 2011 • Moorthi, V. R, Power electronics : devices, circuits and industrial applications, Oxford University Press, 2010 • G.K. Dubey, Power Semiconductor Controlled Drives, Prentice- Hall, 1989	

Textbooks	• Rashid, Muhammad H; Power Electronics Handbook - Devices, Circuits, and Applications, Elsevier, 2011 • Moorthi, V. R, Power electronics : devices, circuits and industrial applications, Oxford University Press, 2010
	• Rashid, Muhammad H; Power Electronics Handbook - Devices, Circuits, and Applications, Elsevier, 2011 • Moorthi, V. R, Power electronics : devices, circuits and industrial applications, Oxford University Press, 2010 • G.K. Dubey, Power Semiconductor Controlled Drives, Prentice- Hall, 1989

<table>
<tr><td>Department</td><td>Electronics Engineering</td><td>Major</td><td colspan="6">Industrial Electronics & Control</td></tr>
<tr><td>Course Name</td><td>Embedded Systems</td><td>Course Code</td><td colspan="6">ELCC 329</td></tr>
<tr><td rowspan="2">Prerequisites</td><td rowspan="2">ELCC 328</td><td rowspan="2">Credit Hours
CRH</td><td colspan="2">3</td><td colspan="2">CTH</td><td colspan="2">5</td></tr>
<tr><td>L</td><td>2</td><td>P</td><td>2</td><td>T</td><td>1</td></tr>
<tr><td colspan="9">CRH: Credit Hours L: Lecture P: Practical T: Tutorial CTH: Contact Hours</td></tr>
</table>

Course Description :

Embedded systems are involved in almost every facet and modern life. Cell phones, pagers, PDAs answering machines, microwaves ovens, televisions, video games consoles, GPS devices, networks routers…

Late model cars may contain as many as 65 embedded microprocessors, controlling such tasks as antilock braking, engine control, audio system control.

In this course the fundamentals of embedded systems hardware and firmware design will be explored. Issues such us embedded processor selection, hardware- firmware partitioning, logic circuit design, circuit layout, circuit debugging, developing tools, firmware architecture, firmware design and firmware debugging..

Topics :

- Converter classification and electronic switches.
- General-purpose processors: Software
- Standard single-purpose processors: Peripherals
- Custom single-purpose processors: Hardware
- Memories
- Interfacing

Experiments: If applicable, it will support the course topics

References :

- Ali Mazidi, Janice Gillispie Mazidi., "The 8051 Microcontroller and Embedded systems", Person Education, 2nd Edition, 2004.
- Dorf R.C., Bishop R.H. Modern control systems, Addison Wesley, 1995.

Detailed of Theoretical Contents		
No.	**Contents**	**Hours**
1	**Introduction to the Course and Embedded Systems** Embedded systems overview, Design challenge – optimizing design metrics, Embedded processor technology, IC technology, Design technology,	**6**
2	**General-purpose processors: Software.**Basic architecture, Operation, Programmer's view, Microcontrollers, Selecting a microprocessor	**8**
3	**Standard single-purpose processors: Peripherals** Timers, counters, and watchdog timers, UART (Universal Asynchronous Receiver/Transmitter), Pulse width modulator, LCD controller, Keypad controller, Stepper motor controller.	**8**
4	**Custom single-purpose processors: Hardware** Combinational logic design, Sequential logic design, Custom single-purpose processor design	**8**
5	**Memories:** Read-only memory – ROM, Read-write memory – RAM, Composing memories.	**8**

6	**Interfacing**: Timing diagrams, Hardware protocol basics, Interfacing with a general-purpose processor, Arbitration, Multi-level bus architectures.	**8**
7	Final Assessment.	**2**

Textbook	• Marwedel, Peter, Embedded System Design : Embedded Systems, Foundations of Cyber-Physical Systems, and the Internet of Things, Springer International Publishing 2018 • Elecia White, Making Embedded Systems: Design Patterns for Great Software, O'Reilly, 2011 • Frank Vahid, Tony Givargis, Embedded System Design: a unified hardware/software introduction, Wiley , 2001

Detailed of Practical Contents		
No.	**Contents**	**Hours**
1.	Assembly Microprocessor Programming	**4**
2.	AVR/ARM programming	**6**
3.	DSP algorithms programming	**6**
4.	Custom single-purpose processor design	**6**
5.	Memory programming and Testing	**4**
6.	Interfacing of LCD display to Microcontroller	**4**
7.	Final Assessment.	**2**
Textbook	• Frank Vahid, Tony Givargis, Embedded System Design: a unified hardware/software introduction, Wiley, 2001.	

Textbooks	• Marwedel, Peter, Embedded System Design : Embedded Systems, Foundations of Cyber-Physical Systems, and the Internet of Things, Springer International Publishing 2018 • Elecia White, Making Embedded Systems: Design Patterns for Great Software, O'Reilly, 2011 • Frank Vahid, Tony Givargis, Embedded System Design: a unified hardware/software introduction, Wiley , 2001
	• Frank Vahid, Tony Givargis, Embedded System Design: a unified hardware/software introduction, Wiley, 2001.

<table>
<tr><td>Department</td><td>Electronics Engineering</td><td>Major</td><td colspan="6">Industrial Electronics & Control</td></tr>
<tr><td>Course Name</td><td>Electro Mechanical Systems</td><td>Course Code</td><td colspan="6">ELCC 427</td></tr>
<tr><td rowspan="2">Prerequisites</td><td rowspan="2">ELCC 333</td><td rowspan="2">Credit Hours
CRH</td><td colspan="2">2</td><td colspan="2">CTH</td><td colspan="2">3</td></tr>
<tr><td>L</td><td>2</td><td>P</td><td>0</td><td>T</td><td>1</td></tr>
<tr><td colspan="9">CRH: Credit Hours L: Lecture P: Practical T: Tutorial CTH: Contact Hours</td></tr>
</table>

Course Description :

Electro Mechanical Systems unit of study introduces the trainees to electrical actuators, electro-hydraulic systems, Analysis of common power electronic schemes required for electromagnetic motion devices. Modeling and simulation of electrically driven magnetic motion systems and drive electronics using MATLAB and Simulink. Equations of motion governing DC and AC motors. Performance characteristics of various DC and AC Motor Designs simulated using MATLAB and Simulink.

Topics :

- Introduction to Electromechanical Systems
- Analysis of Electromechanical Systems
- Review of Electromagnetism
- Review of Classical Mechanics
- Introduction to Power Electronics
- Modeling and Application of Op. Amps., Power Amplifiers, and Power Converters
- DC Electric Machines and Motor Devices
- Modeling and Simulation of DC Electric Motors
- DC Electric Machines with Power Electronics
- Induction Machines (some advanced topics)
- Torque Characteristics
- Simulation of AC Induction Motors using MATLAB and Simulink
- Synchronous Machines (advanced topic)
- Digital PID Control Laws and application involving Servo system with Permanent Magnet DC Motor

Experiments: If applicable, it will support the course topics

References :

- S.E. Lyshevski, Electromechanical Systems and Devices, CRC Press, 2008
- S.E. Lyshevski, Engineering and Scientific Computations using MATLAB, Wiley, 2003
- C.W. de Silva, Mechatronics: an Integrated Approach, CRC Press, 2004.

Detailed of Theoretical Contents		
No.	**Contents**	**Hours**
1	Introduction to Electromechanical Systems:	**2**
2	Analysis of Electromechanical Systems	**4**

3	Review of Electromagnetism: Electromagnetic (EM) Theory, Maxwell's Equations, Light is a traveling EM wave, Electromagnetic Radiation, Sources of EM Energy.	**4**
4	Review of Classical Mechanics	**4**
5	Introduction to Power Electronics: Power Electronic Devices, Power Electronic Circuits and Controls, Applications and Systems Considerations	**2**
6	Modeling and Application of Op. Amps., Power Amplifiers, and Power Converters	**4**
7	DC Electric Machines and Motor Devices: classification of electrical machines, basic features of electrical machines, basic principal of operation.	**4**
8	Modeling and Simulation of DC Electric Motors: introduction, the mathematical model of the DC motor, simulation of the DC motor.	**4**
9	DC Electric Machines with Power Electronics	**4**
10	Induction Machines (some advanced topics)	**2**
11	Torque Characteristics: Induction Machine Vector Control System Description, Evaluation Board Selection, Signal Conditioning.	**4**
12	Simulation of AC Induction Motors using MATLAB and Simulink	**4**
13	Synchronous Machines (advanced topic): Synchronous condensers, Superconducting synchronous condensers, Synchronous machine models, State estimation applied to synchronous generators	**4**
14	Final assessment	**2**
Textbook	• S.E. Lyshevski, Electromechanical Systems and Devices, CRC Press, 2008. • H.D. Chai, Electromechanical Motion Devices, Prentice Hall, 1998.	

Textbooks	• S.E. Lyshevski, Electromechanical Systems and Devices, CRC Press, 2008. • H.D. Chai, Electromechanical Motion Devices, Prentice Hall, 1998.

<table>
<tr><td>Department</td><td>Electronics Engineering</td><td>Major</td><td colspan="6">Industrial Electronics & Control</td></tr>
<tr><td>Course Name</td><td>Electric Drives</td><td>Course Code</td><td colspan="6">ELCC434</td></tr>
<tr><td rowspan="2">Prerequisites</td><td rowspan="2">ELCC452</td><td rowspan="2">Credit Hours
CRH</td><td colspan="2">3</td><td colspan="2">CTH</td><td colspan="2">5</td></tr>
<tr><td>L</td><td>2</td><td>P</td><td>2</td><td>T</td><td>1</td></tr>
<tr><td colspan="9">CRH: Credit Hours L: Lecture P: Practical T: Tutorial CTH: Contact Hours</td></tr>
</table>

Course Description :

Motion control in industrial, commercial and transportation systems is carried out using electrical drives. This course provides students with the working knowledge of various components of an electrical drive system and their control. After completion of this course, students are expected to select and size electrical drives for any given application in an efficient manner and should be able to perform design of different drive components. The topics covered are: characteristics and sizing of power semiconductor controlled electric drives; DC motor drives: speed and torque control; induction motor drives: voltage control and variable frequency control; synchronous motor drives: open-loop, closed-loop variable frequency control; brushless DC drives; drives application examples

Topics :

- Introduction: Power devices and switching motor drive.
- Modeling of DC machine.
- Phase controlled DC motor drive.
- Chopper controlled DC motor drive.
- Polyphase induction machine modeling.
- Phase controlled induction motor drive.
- Frequency controlled induction motor drive.
- Vector controlled induction motor drive.
- Permanent-Magnet Synchronous and brushless DC motor drive.

Experiments: If applicable, it will support the course topics

References :

- R Krishnan, "Electric Motor Drives - Modeling, Analysis and Control", Prentice Hall, Last Edition.
- Electric Drives, N. Mohan, MNPERE, 2007 edition.
- G.K. Dubey, Fundamentals of Electric Drives, Narose Publishing House, second edition,2002
- David Finney, Variable Frequency AC motor Drive Systems, Peter Peregrinus Ltd, London, 1988.

Detailed of Theoretical Contents		
No.	**Contents**	**Hours**
1	Introduction: Power devices and switching motor drive.	**3**

2	Modeling of DC machine.	**6**
3	Phase controlled DC motor drive.	**4**
4	Chopper controlled DC motor drive.	**6**
5	Polyphase induction machine modeling.	**6**
6	Phase controlled induction motor drive.	**4**
7	Frequency controlled induction motor drive.	**5**
8	Vector controlled induction motor drive.	**6**
9	Permanent-Magnet Synchronous and brushless DC motor drive.	**6**
10	Final Assessment.	**2**
Textbook	• R Krishnan, "Electric Motor Drives - Modeling, Analysis and Control", Prentice Hall, Last Edition**.**	

Detailed of Practical Contents		
No.	**Contents**	**Hours**
1.	Phase controlled DC machine.	**6**
2.	**DC machine drive:** -Buck converter - H converter	**6**
3.	Phase controlled Induction machine	**4**
4.	**Induction machine drive:** - DC/AC converter - V/f control strategy - Vectorial control - Direct Torque Control DTC - Active Breaking	**12**
5.	Final Assessment.	**4**
Textbook	• R Krishnan, "Electric Motor Drives - Modeling, Analysis and Control", Prentice Hall, Last Edition.	

Textbooks	• R Krishnan, "Electric Motor Drives - Modeling, Analysis and Control", Prentice Hall, Last Edition.

<table>
<tr><td>Department</td><td colspan="2">Electronics Engineering</td><td>Major</td><td colspan="6">Industrial Electronics & Control</td></tr>
<tr><td>Course Name</td><td colspan="2">Robotics</td><td>Course Code</td><td colspan="6">ELCC 464</td></tr>
<tr><td rowspan="2">Prerequisites</td><td colspan="2" rowspan="2">ELCC 322</td><td rowspan="2">Credit Hours
CRH</td><td colspan="2">3</td><td colspan="2">CTH</td><td colspan="2">5</td></tr>
<tr><td>L</td><td>2</td><td>P</td><td>2</td><td>T</td><td>1</td></tr>
<tr><td colspan="10">CRH: Credit Hours L: Lecture P: Practical T: Tutorial CTH: Contact Hours</td></tr>
</table>

Course Description :

Design of robotics systems that combine embedded hardware, software, mechanical subsystems, and fundamental algorithms for sensing and control to expose students to basic concepts in robotics and current state of the art. Lecture closely tied to design laboratory where students work in teams to construct series of subsystems leading to final project.

Topics :

- Overview of Robots
- Gripper Design
- Position Velocity Sensors
- Actuators
- Robot Control
- Robot Coordinate Systems
- Robots Kinematics
- Differential Motion and the Jacobian
- Task Space Trajectory Planning
- Joint space Trajectory Planning
- Robots Dynamics
- Robots Programming Languages
- Computer Vision

Experiments: If applicable, it will support the course topics

References :

- Mordechai Ben-Ari, Francesco Mondada, Elements of Robotics, Springer, 2018
- Lepuschitz, Wilfried, Robotics in education : latest results and developments, Springer, 2018
- T. Braunl, Embedded Robotics: Mobile Robot Design and Applications with Embedded Systems, 2006.

Detailed of Theoretical Contents		
No.	**Contents**	**Hours**
1	Introduction	2
2	Overview of Robots	2
3	Gripper Design	2
4	Position Velocity Sensors	2
5	Actuators	2
6	Robot Control	4
7	Robot Coordinate Systems	2

8	Robots Kinematics	6
9	Differential Motion and the Jacobian	4
10	Task Space Trajectory Planning	4
11	Joint space Trajectory Planning	4
12	Robots Dynamics	4
13	Robots Programming Languages	4
14	Computer Vision	4
15	Final assessment	2

Textbook	• Mordechai Ben-Ari, Francesco Mondada, Elements of Robotics, Springer, 2018 • Lepuschitz, Wilfried, Robotics in education : latest results and developments, Springer, 2018 • T. Braunl, Embedded Robotics: Mobile Robot Design and Applications with Embedded Systems, 2006.

Detailed of Practical Contents		
No.	**Contents**	**Hours**
1.	Introduction	2
2.	Interface to and process data from sensors	2
3.	Interface to and process commands to actuators	2
4.	Design embedded controllers with sensors/actuators	2
5.	Inverse kinematics of robotic mechanisms	2
6.	Control of robotic mechanisms	2
7.	Robot path planning algorithms	4
8.	Robot system architecture organization	2
9.	Robotics related platforms and tools	4
10.	Robotic and embedded system standards	2
11.	Design robot system for given task goal	2
12.	Design H/W and S/W for robotic embedded system	2
13.	Implement real-time event-based robot control	2
14.	Final Assessment	2

Textbook	• Lepuschitz, Wilfried, Robotics in education : latest results and developments, Springer, 2018

	• F. Martin, Robotics Explorations: A Hands-on introduction to Engineering, Prentice-Hall 2001.

Textbooks	• Mordechai Ben-Ari, Francesco Mondada, Elements of Robotics, Springer, 2018 • Lepuschitz, Wilfried, Robotics in education : latest results and developments, Springer, 2018 • T. Braunl, Embedded Robotics: Mobile Robot Design and Applications with Embedded Systems, 2006.
	• Lepuschitz, Wilfried, Robotics in education : latest results and developments, Springer, 2018 • F. Martin, Robotics Explorations: A Hands-on introduction to Engineering, Prentice-Hall 2001.

<table>
<tr><td>Department</td><td>Electronics Engineering</td><td>Major</td><td colspan="6">Industrial Electronics & Control</td></tr>
<tr><td>Course Name</td><td>Digital Control Systems</td><td>Course Code</td><td colspan="6">ELCC 437</td></tr>
<tr><td rowspan="2">Prerequisites</td><td rowspan="2">ELCC 432</td><td rowspan="2">Credit Hours
CRH</td><td colspan="2">3</td><td colspan="2">CTH</td><td colspan="2">5</td></tr>
<tr><td>L</td><td>2</td><td>P</td><td>2</td><td>T</td><td>1</td></tr>
<tr><td colspan="9">CRH: Credit Hours L: Lecture P: Practical T: Tutorial CTH: Contact Hours</td></tr>
</table>

Course Description :

The course introduces the fundamental concepts, principles and applications of the digital control system. The topics cover modern control design techniques, including, Discrete systems dynamics, sampled-data systems, Z-transform, digital transfer functions, state space models and digital controllers design. A number of chosen real problems are solved to illustrate the concepts clearly.

Topics :

- Overview of Digital Control System
- Discrete-Time Systems and the z-Transform
- Sampling and reconstruction
- Open-Loop Discrete-Time Systems
- Closed-loop systems
- system time-response Characteristics, System Time Response, System Characteristic Equation,
- stability analysis techniques
- Digital Controller design
- pole-assignment design and state estimation
- system identification of discrete-time systems
- linear quadratic optimal Control
- Case studies

Experiments: If applicable, it will support the course topics

References :

- Charles L. Phillips • H. Troy Nagle • Aranya Chakraborttym, digital Control System analysis and design, Fourth Edition 2015 Pearson Education Limited, Edinburgh Gate Harlow Essex, England
- Anastasia Veloni Nikolaos I. Miridakis, Digital Control Systems Theoretical Problems and Simulation Tools, CRC Press Taylor & Francis Group, 6000 Broken Sound Parkway NW
- M. Sami Fadali and Antonio Visioli, Digital Control Engineering Analysis and Design, Second Edition, Academic Press 2013 Elsevier Inc.

Software:

- MATLAB: Control and Simulink Tool Boxes, Math Works Inc.

Detailed of Theoretical Contents		
No.	**Contents**	**Hours**
1	**Overview of Digital Control System** The Control Problem examples, Servomotor System Model, Antenna Pointing System, Robotic Control System, Temperature Control System, Single-Machine Infinite Bus Power System	3
2	**Discrete-Time Systems and the z-Transform** Discrete-Time Systems, Transform Methods, Properties of the z-Transform, Addition and Subtraction, Multiplication by a Constant, Real Translation, Complex Translation, Initial Value , Final Value, Finding z-Transforms, Solution of Difference Equations, The Inverse z-Transform, Power Series	5

	Method , Partial-Fraction Expansion Method, inversion-Formula Method, Discrete Convolution , Simulation Diagrams and Flow Graphs, State Variables, Other State-Variable Formulations, Transfer Functions, Solutions of the State Equations, Recursive Solution, z-Transform Method, Numerical Method via Digital Computer, Properties of the State Transition Matrix, Linear Time-Varying Systems	
3	**Sampling and reconstruction** Sampled-Data Control Systems, The Ideal Sampler, Data Reconstruction, Zero-Order Hold, First-Order Hold, Fractional-Order Holds	**4**
4	**Open-Loop Discrete-Time Systems** the Pulse Transfer Function, Open-Loop Systems Containing Digital Filters, The Modified z-Transform Systems with Time Delays, Nonsynchronous Sampling, State-Variable Models, Review of Continuous-Time State Variables, Discrete-Time State Equations, Practical Calculations	**4**
5	**Closed-loop systems** Derivation procedure, State-Variable Models,	**3**
6	**System time-response Characteristics** System Time Response, System Characteristic Equation, Mapping the s-Plane into the z-Plane, Steady-State Accuracy,	**3**
7	**stability analysis techniques** Stability concept, Bilinear Transformation, The Routh-Hurwitz Criterion, Jury's Stability Test, Root Locus, The Nyquist Criterion, The Bode Diagram, Interpretation of the Frequency Response, Closed-Loop Frequency Response	**6**
8	**Digital Controller Design** Control System Specifications, Steady-State Accuracy, Transient Response, Relative Stability, Sensitivity, Disturbance Rejection, Control Effort, Compensation, Phase-Lag Compensation, Phase lead compensation, Phase-Lead Design Procedure, Lag-Lead Compensation, Integration and Differentiation Filters, PID Controllers, PID Controller Design, Design by Root Locus, Control System Specifications, Steady-State Accuracy, Transient Response, Relative Stability, Sensitivity, Disturbance Rejection, Control Effort, Compensation, Phase-Lag Compensation, Phase lead compensation, Phase-Lead Design Procedure, Lag-Lead Compensation, Integration and Differentiation Filters, PID Controllers, PID Controller Design, Design by Root Locus,	**6**
9	**pole-assignment design and state estimation** Pole Assignment, State Estimation, Observer Model, Errors in Estimation, Error Dynamics, Controller Transfer Function, Closed-Loop Characteristic Equation, Closed-Loop State Equations, Reduced-Order Observers, Current Observers, Controllability and Observability, Systems with Inputs	**6**
10	**Case studies** Servomotor System, System Model, Design, Environmental Chamber Control System, Temperature Control System, Aircraft Landing System, Plant Model, Design, Neonatal Fractional Inspired Oxygen, Plant Transfer Function, Taube's PID Controller, Topology Identification in Electric Power System Models.	**6**
11	Final Assessment.	**2**

Textbook	• Charles L. Phillips H. Troy Nagle and Aranya Chakraborttym, Digital Control System Analysis and Design, Fourth Edition 2015 Pearson Education Limited, Edinburgh Gate Harlow Essex, England.

Detailed of Practical Contents		
No.	**Contents**	**Hours**
1.	Discrete-time simulation with MATLAB Simulink.	**2**
2.	Time-domain controller simulation	**2**
3.	Frequency-domain controller simulation.	**2**
4.	Sampling, aliasing, zero-order hold	**2**

5.	Discrete-time plant modeling	**2**
6.	Filter structure and finite-precision effects.	**4**
7.	Frequency-response controller design.	**4**
8.	Numeric optimal PID controller design.	**4**
9.	State-feedback controller design.	**4**
10.	State estimation and control design.	**2**
11.	Digital Control of a DC Motor	**2**
12.	Final Assessment.	**2**
Textbook	• Cheng Siong Chin, COMPUTER AIDED CONTROL SYSTEMS DESIGN, Practical Applications Using MATLAB® and Simulink, 2013 by Taylor & Francis Group, LLC.	

Textbooks	• Charles L. Phillips H. Troy Nagle and Aranya Chakraborttym, Digital Control System Analysis and Design, Fourth Edition 2015 Pearson Education Limited, Edinburgh Gate Harlow Essex, England.
	• Cheng Siong Chin, COMPUTER AIDED CONTROL SYSTEMS DESIGN, Practical Applications Using MATLAB® and Simulink, 2013 by Taylor & Francis Group, LLC.

<table>
<tr><td>Department</td><td>Electronics Technology</td><td>Major</td><td colspan="6">Industrial Electronics & Control</td></tr>
<tr><td>Course Name</td><td>Renewable energy technologies</td><td>Course Code</td><td colspan="6">ELCC411</td></tr>
<tr><td rowspan="2">Prerequisites</td><td rowspan="2">ELCC341</td><td rowspan="2">Credit Hours
CRH</td><td colspan="2">2</td><td colspan="2">CTH</td><td colspan="2">3</td></tr>
<tr><td>L</td><td>2</td><td>P</td><td>0</td><td>T</td><td>1</td></tr>
<tr><td colspan="9">CRH: Credit Hours L: Lecture P: Practical T: Tutorial CTH: Contact Hours</td></tr>
</table>

Course Description :

This course discusses the use of solar energy (thermal and photovoltaic), wind, geothermal, as well as energy heat transfer. The potential of using renewable energy technologies to the extent possible, replacement for conventional technologies, and the possibility of combining renewable and non-renewable energy technologies in hybrid systems.

In the end of the course, students will be able to:

- describe the fundamentals and main characteristics of renewable energy sources and their differences compared to fossil fuels.
- Explain the technological basis for harnessing renewable energy sources.
- Recognize the effects that current energy systems based on fossil fuels have over the environment and the society

Topics :

- Principles of renewable energy
- Photovoltaic Cells
- Power from the wind
- Heat transfer
- Geothermal Energy

Experiments: If applicable, it will support the course topics

References :

Detailed of Theoretical Contents		
No.	**Contents**	**Hours**
1	**Principles of renewable energy:** Energy and sustainable development, Fundamentals, Scientific principles of renewable energy, Technical implications, Social implications, Problems	8
2	**Photovoltaic Cells:** Crystal Structure, Cell Physics, Energy Bands, Electrons and Their Energy, Direct and Indirect, Band-Gap Materials, Doping, Generation and Recombination, The p–n Junction, Solar Cell Equations, Characterization, Efficiency, Cell Applications, Problems	8
3	**Power from the wind:** Turbine types and terms, Linear momentum and basic theory, Blade element theory, Characteristics of the wind, Power extraction by a turbine, Electricity generation, Social and environmental considerations, Problems	10
4	**Heat transfer:** Heat circuit analysis and terminology, Conduction, Convection, Radiative heat transfer, Properties of 'transparent' materials, Heat transfer, Problems.	10
5	**Geothermal Energy:** Geophysics, Dry rock and hot aquifer analysis, Harnessing Geothermal Resources, Social and environmental aspects , Problems	10
6	Final Assessment	2

Textbook	• D. Chandrasekharam and J. Bundschuh Hb: Spon Press. • V. Bentivegna, P.S. Brandon and P. Lombardi Hb: Spon Press.

<table>
<tr><td>Department</td><td>Electronics Engineering</td><td>Major</td><td colspan="6">Industrial Electronics & Control</td></tr>
<tr><td>Course Name</td><td>Digital Communication Systems</td><td>Course Code</td><td colspan="6">ELCC473</td></tr>
<tr><td rowspan="2">Prerequisites</td><td rowspan="2">ELCC325</td><td rowspan="2">Credit Hours
CRH</td><td colspan="2">3</td><td colspan="2">CTH</td><td colspan="2">5</td></tr>
<tr><td>L</td><td>2</td><td>P</td><td>2</td><td>T</td><td>1</td></tr>
<tr><td colspan="9">CRH: Credit Hours L: Lecture P: Practical T: Tutorial CTH: Contact Hours</td></tr>
</table>

Course Description :

This course covers the techniques of modern digital communication systems. Special emphasis is placed on the Review of the digital communication, Coding for discrete sources, Quantization, Source and channel waveforms, modulation, and demodulation (PSK, FSK, ASK, QAM) Introduction to Wireless communication.

Students are expected to demonstrate the ability to:

- Understand basic components of digital communication systems.
- Design optimum receivers for digital modulation techniques.
- Analyze the error performance of digital modulation techniques.

Design digital communication systems under given power, spectral and error performance constrains.

Topics :

- Introduction to digital communication
- Channel Coding
- Digital Baseband Transmission
- Digital Modulations of the Sinusoidal Carrier
- Properties of Communication Channels
- Synchronization in Digital Communication Systems
- Multiple Access Techniques

Experiments: If applicable, it will support the course topics

Detailed of Theoretical Contents		
No.	**Contents**	**Hours**
1	**Introduction to digital communication:** Standardized interfaces and layering, Communication sources, Source coding, Communication channels, Channel encoding (modulation), Error correction, Digital interface, Network aspects of the digital interface	4
2	**Channel Coding:** Classification of Codes, Hard- and Soft-Decision Decoding, Coding Gain, Hamming Codes, The Iterated Code, Polynomial Codes, Code word Generation for the, Polynomial Codes, Cyclic Codes	6
3	**Digital Baseband Transmission:** Shaping of Elementary Signals, Selection of the Data, Symbol Format, Optimal Synchronous Receiver, Error Probability in the Optimal Receiver for M-PAM Signals, Case Study: Baseband Transmission in Basic Access ISDN Systems	6
4	**Digital Modulations of the Sinusoidal Carrier:** Optimal Synchronous Receiver, Optimal Asynchronous Receiver, ASK Modulation, Synchronous Receiver for ASK-Modulated Signals, Asynchronous Reception of ASK-Modulated Signals, Error Probability on the Output of the Asynchronous ASK	8
5	**Properties of Communication Channels:** Baseband Equivalent Channel, Telephone Channel, Basic Elements of the Telephone Network Structure, Telephone Channel Properties, Properties of a Subscriber Loop Channel, Line-of-Sight Radio Channel, Mobile Radio Channel	8

6	**Synchronization in Digital Communication Systems:** Phase-locked loop for continuous signals, Phase-Locked Loop for Sampled Signals, Maximum Likelihood Carrier Phase Estimation, Practical Carrier Phase Synchronization Solutions, Timing Synchronization.	6
7	**Multiple Access Techniques:** Frequency Division Multiple Access, Time Division Multiple Access, Code Division Multiple Access, Single-Carrier CDMA, Multi-Carrier CDMA, Orthogonal Frequency Division Multiple Access, Single-Carrier FDMA, Space Division Multiple Access, Case Study: Multiple Access Scheme in the 3GPP LTE Cellular System	8
8	Final Assessment.	2

Textbook	• S. Haykin and M. Moher, Introduction to Analog & Digital Communications, 2nd ed., John Wiley & Sons, Inc., 2007 • M. Pursley, Intorduction to Digital Communications, Prentice-Hall, Englewood Cliffs, NJ, 2005. • Krzysztof Wesolowski, Introduction to digital communication systems, John Wiley & Sons, Ltd 2009

Detailed of Practical Contents		
No.	**Contents**	**Hours**
1.	Pulse Amplitude Modulation (PAM) and Demodulation	4
2.	Pulse Width Modulation (PWM) and Demodulation	2
3.	Pulse Position Modulation (PPM) and Demodulation	4
4.	Pulse Code Modulation (PCM) and demodulation and observe the waveforms	4
5.	Amplitude Shift Keying (ASK) Modulator and Demodulator	4
6.	Phase Shift Keying (PSK) Modulator and Demodulator.	2
7.	Frequency Shift Keying (FSK) Modulator and Demodulator.	2
8.	Time Division Multiplexing	4
9.	Data Formatting	4
10.	Final assessment	2

Textbook	• S. Haykin and M. Moher, Introduction to Analog & Digital Communications, 2nd ed., John Wiley & Sons, Inc., 2007 • M. Pursley, Intorduction to Digital Communications, Prentice-Hall, Englewood Cliffs, NJ, 2005. • Krzysztof Wesolowski, Introduction to digital communication systems, John Wiley & Sons, Ltd 2009

Textbooks	• S. Haykin and M. Moher, Introduction to Analog & Digital Communications, 2nd ed., John Wiley & Sons, Inc., 2007 • M. Pursley, Intorduction to Digital Communications, Prentice-Hall, Englewood Cliffs, NJ, 2005. • Krzysztof Wesolowski, Introduction to digital communication systems, John Wiley & Sons, Ltd 2009

<table>
<tr><td>Department</td><td>Electronics Engineering</td><td>Major</td><td colspan="6">Industrial Electronics & Control</td></tr>
<tr><td>Course Name</td><td>Integrated VLSI Circuit Design</td><td>Course Code</td><td colspan="6">ELCC442</td></tr>
<tr><td rowspan="2">Prerequisites</td><td rowspan="2">ELCC 329</td><td rowspan="2">Credit Hours
CRH</td><td colspan="2">2</td><td colspan="2">CTH</td><td colspan="2">2</td></tr>
<tr><td>L</td><td>2</td><td>P</td><td>0</td><td>T</td><td>0</td></tr>
<tr><td colspan="9">CRH: Credit Hours L: Lecture P: Practical T: Tutorial CTH: Contact Hours</td></tr>
</table>

Course Description :

This is an introductory course, which covers basic theories and techniques of digital VLSI design in CMOS technology. In this course, we will study the fundamental concepts and structures of designing digital VLSI systems include CMOS devices and circuits, standard CMOS fabrication processes, CMOS design rules, static and dynamic logic structures interconnect analysis, CMOS chip layout, simulation and testing, low power techniques, design tools and methodologies, VLSI architecture. The course is designed to give the student an understanding of the different design steps required to carry out a complete digital VLSI (Very-Large-Scale Integration) design in silicon.

Topics :

- Introduction to VLSI Systems.
- CMOS logic, fabrication and layout
- MOS Transistor theory
- Layout Design Rules
- Circuit characterization and performance estimation
- Circuit Simulation
- Combinational and sequential circuit design
- Memory system design
- Design methodology and tools

Experiments: If applicable, it will support the course topics

References:

- Digital Design, 3rd edition by M. Morris Mano.
- Principles of CMOS VLSI design by N H E Weste& K Eshraghian
- Modern VLSI Design: System on Silicon by Wayne Wolf.

Detailed of Theoretical Contents		
No.	**Contents**	**Hours**
1	Introduction to VLSI Systems.	2
2	CMOS logic, fabrication and layout	2
3	MOS Transistor theory	2
4	Layout Design Rules	4
5	Circuit characterization and performance estimation	4
6	Circuit Simulation	4
7	Combinational and sequential circuit design	4
8	Memory system design	4

9	Design methodology and tools	**4**
10	Final Assessment	**2**
Textbook	• Weste& Harris, CMOS VLSI Design: A Circuits and Systems Perspective, 3rd ed, Addison Wesley, 2005	

Textbooks	• Weste& Harris, CMOS VLSI Design: A Circuits and Systems Perspective, 3rd ed, Addison Wesley, 2005.

ELECTIVES 1

<table>
<tr><td>Department</td><td>Electronics Engineering</td><td>Major</td><td colspan="6">Industrial Electronics & Control</td></tr>
<tr><td>Course Name</td><td>Artificial Intelligence</td><td>Course Code</td><td colspan="6">ELCC 474</td></tr>
<tr><td rowspan="2">Prerequisites</td><td rowspan="2">ELCC 331</td><td rowspan="2">Credit Hours
CRH</td><td colspan="2">4</td><td colspan="2">CTH</td><td colspan="2">6</td></tr>
<tr><td>L</td><td>3</td><td>P</td><td>2</td><td>T</td><td>1</td></tr>
<tr><td colspan="9">CRH: Credit Hours L: Lecture P: Practical T: Tutorial CTH: Contact Hours</td></tr>
</table>

Course Description :

This course provides an overview and introduction to the field of Artificial Intelligence. Notions of rational behavior and intelligent agents will be discussed. Major subareas will be covered. The emphasis will be on understanding the fundamental concepts, as well as being able to practically apply the corresponding approaches in solving practical problems and developing useful software applications. Program illustrations in traditional languages such as C and Java and Matlab toolbox will be used. General understanding of major concepts and approaches in knowledge representation, planning, learning, robotics and other AI areas.

Topics :

- Introduction to Artificial Intelligence. Sub-areas.
- Intelligent agents
- Problem solving
- Introduction to knowledge representation
- Planning
- Machine learning
- Artificial neural networks
- Fuzzy Logic control
- ANFIS applications in control systems
- Robotics Applications
- Review of basic LISP constructs: macros, mapping, primitives, LAMBDA definitions, Advanced LISP, programming: structures, lexical and special, variables, generators and encapsulation, procedures, returning multiple values.
- Logic-based TMSs: representing negation and Boolean, constraint propagation.

Experiments: If applicable, it will support the course topics

References :

- Artificial Intelligence: Structures and Strategies for Complex Problem Solving, 6th ed. G. Luger, Addison Wesley, 2009

Detailed of Theoretical Contents		
No.	**Contents**	**Hours**
1	Introduction to Artificial Intelligence. Sub-areas.	**4**
2	Intelligent agents	**6**
3	Problem solving	**6**
4	Introduction to knowledge representation	**6**
5	Planning	**6**
6	Machine learning	**8**
7	Artificial neural networks	**6**

8	Fuzzy Logic control	**8**
9	ANFIS applications in control systems	**6**
10	Robotics Applications	**6**
11	Final Assessment	**2**

Textbook	• Stuart J. Russell and Peter Norvig, Artificial Intelligence: A Modern Approach (3rd Edition), Pearson Education Limited 2016 • Artificial Intelligence: A Modern Approach (3rd Edition) by Stuart Russell, Peter Norvig. • S. Haykin, "Neural Networks: A Comprehensive Foundation", Prentice Hall, Last Edition

Detailed of Practical Contents		
No.	**Contents**	**Hours**
1.	Introduction to MATLAB programming	**4**
2.	Artificial neural networks programming with MATLAB	**4**
3.	Hebb algorithm programming	**8**
4.	Fuzzy controller system for Image Processing	**4**
5.	Fuzzy PID Controller	**8**
6.	Robotics Applications using genetic algorithms	**2**
7.	Final Assessment	**2**

Textbook	• ANFIS toolbox in MATLAB • Russell, Stuart Jonathan (Author), Norvig, Peter Artificial intelligence: a modern approach 2014.

Textbooks	• Stuart J. Russell and Peter Norvig, Artificial Intelligence: A Modern Approach (3rd Edition), Pearson Education Limited 2016 • Artificial Intelligence: A Modern Approach (3rd Edition) by Stuart Russell, Peter Norvig. • S. Haykin, "Neural Networks: A Comprehensive Foundation", Prentice Hall, Last Edition
	• ANFIS toolbox in MATLAB • Russell, Stuart Jonathan (Author), Norvig, Peter Artificial intelligence: a modern approach 2014.

Department	Electronics Engineering	Major	Industrial Electronics & Control					
Course Name	Mechatronics	Course Code	ELCC428					
Prerequisites	ELCC322	Credit Hours CRH	4			CTH		6
			L	3	P	2	T	1
CRH: Credit Hours	L: Lecture	P: Practical	T: Tutorial	CTH: Contact Hours				

Course Description :
Modern products (such as automobiles, cameras, medical equipment, space craft, communication satellites, etc.) and manufacturing equipment (such as 3D printers, CNC machines, industrial robotics and autonomous systems, etc.) contain numerous computers and mechatronics modules. Their creations require engineers to be able to combine mechanical, electric, electronic and software subsystems using advanced scientific and engineering knowledge.
This course introduces to students the basic mechatronics system components, and the design principles of using mechatronics to meet functionality requirements of products, processes and systems. Several lab-oriented assignments and team-based course projects are presented with innovative case studies in diverse application domains. The course will also prepare the students to read literature, understand research problems, and identify possible innovations to the field.

Topics :
- Introduction and mechatronics
- Micro-controllers and electrical components
- Actuators and control
- Mechanical components & Mechanisms
- Programmable motion control and algorithm development
- Sensors
- Closed loop control
- Digital fabrication and 3D printing
- Digital control
- Robotics and autonomous systems

Experiments: If applicable, it will support the course topics
References :

- De Silva, Clarence W.; Halgamuge, Saman K.; Khoshnoud, Farbod; Li, Maoqing, Mechatronics: fundamentals and applications, CRC Press, 2016.
- Felix Hüning, Fundamentals of Electrical Engineering for Mechatronics, De Gruyter Oldenbourg, 2014.

Detailed of Theoretical Contents		
No.	**Contents**	**Hours**
1	Introduction and mechatronics	3
2	Micro-controllers and electrical components	8
3	Actuators and control	6
4	Mechanical components & Mechanisms	6

5	Programmable motion control and algorithm development	**8**
6	Sensors	**5**
7	Closed loop control	**6**
8	Digital fabrication and 3D printing	**6**
9	Multi-mechatronics systems	**6**
10	Robotics and autonomous systems,	**8**
11	Final Assessment.	**2**
Textbook	• De Silva, Clarence W.; Halgamuge, Saman K.; Khoshnoud, Farbod; Li, Maoqing, Mechatronics : fundamentals and applications, CRC Press, 2016 • Felix Hüning, Fundamentals of Electrical Engineering for Mechatronics, De Gruyter Oldenbourg, 2014.	

Detailed of Practical Contents		
No.	**Contents**	**Hours**
1.	Mechatronic systems modeling	**6**
2.	Actuators	**6**
3.	Sensors and conditioner	**4**
4.	Micro-controller and DSP programming	**6**
5.	Case study	**6**
6.	Final Assessment.	**4**
Textbook	• Sabri Cetinkunt, Mechatronics,Wiley, 2006.	

Textbooks	• De Silva, Clarence W.; Halgamuge, Saman K.; Khoshnoud, Farbod; Li, Maoqing, Mechatronics : fundamentals and applications, CRC Press, 2016 • Felix Hüning, Fundamentals of Electrical Engineering for Mechatronics, De Gruyter Oldenbourg, 2014.
	• Sabri Cetinkunt, Mechatronics,Wiley, 2006.

<table>
<tr><td>Department</td><td>Electronics Engineering</td><td>Major</td><td colspan="6">Industrial Electronics & Control</td></tr>
<tr><td>Course Name</td><td>Programming Logic Circuits</td><td>Course Code</td><td colspan="6">ELCC435</td></tr>
<tr><td rowspan="2">Prerequisites</td><td rowspan="2">ELCC325</td><td rowspan="2">Credit Hours
CRH</td><td colspan="2">4</td><td colspan="2">CTH</td><td colspan="2">6</td></tr>
<tr><td>L</td><td>3</td><td>P</td><td>2</td><td>T</td><td>1</td></tr>
<tr><td colspan="9">CRH: Credit Hours L: Lecture P: Practical T: Tutorial CTH: Contact Hours</td></tr>
</table>

Course Description :
An introductory course on programmable logic controllers (PLCs). Topics include an overview of PLCs, PLC hardware components, basics of PLC programming, development of fundamental PLC ladder programming, timers and counters, data manipulation, concepts in analog data I/O advanced programming techniques, PLC sensors and actuators, and PLC communication Networks. Classroom instruction is supported by laboratory activities through which students use PLCs to perform industrial control functions, troubleshooting, and networking PLCs in situations of typical industrial projects.

Topics :
- Programmable Logic Controllers
- Input/Output Devices
- Digital Systems
- Input/Output Processing
- Ladder and Functional Block Programming
- Programming Methods
- Internal Relays
- Jump and Call
- Timers
- Counters
- Shift Registers
- Data Handling
- Designing Systems
- Programs
- PLC Process application
- Advanced PLC topics and networks

Experiments: If applicable, it will support the course topics

References :

- William Bolton, Programmable Logic Controllers, sixth edition 2015, Linacre House, Jordan Hill, Oxford OX2 8DP, UK
- L. A. Bryan,E. A. Bryan THEORY AND IMPLEMENTATIONPROGRAMMABLECONTROLLERS, An Industrial Text Company Publication Atlanta Georgia USA Second Edition
- S7-1200 Programmable controller - Industry Support Siemens 2017
- H. Jack, Automating Manufacturing Systems with PLCs, Lulu Press, Inc, 2010

Detailed of Theoretical Contents		
No.	**Contents**	**Hours**
1	Programmable Logic Controllers: Controllers, Hardware, Internal Architecture, PLC Systems	**2**

2	Input/output Devices: Input Devices, Output Devices, Examples of Applications	**2**
3	Digital Systems: The Binary System, Octal and Hexadecimal, Numbers in the Binary, Octal, Hex, and BCD Systems, Binary Arithmetic, PLC Data, Combinational Logic Systems, Sequential Logic Systems	**2**
4	Input/output Processing: Input/output Units, Signal Conditioning, Remote Connections, Protocols, Networks, Examples of Commercial Systems, Processing Inputs, Input/output Addresses	**6**
5	Ladder and Functional Block Programming: Ladder Diagrams, Logic Functions, Latching, Multiple Outputs, Entering Programs, Function Blocks, Program Examples	**4**
6	Programming Methods: Instruction Lists, Sequential Function Charts, Structured Text,	**2**
7	Internal Relays: Internal Relays, Ladder Programs, Battery-Backed Relays, One-Shot Operation, Set and Reset, Master Control Relay,	**4**
8	Jump and Call: Jump, Subroutines,	**4**
9	Timers: Types of Timers, On-Delay Timers, Off-Delay Timers, Pulse Timers, Retentive Timers, Programming Examples	**4**
10	Counters: Forms of Counter, Programming, Up- and Down-Counting, Timers with Counters, Sequencer	**4**
11	Shift Registers: Shift Registers, Ladder Programs,	**4**
12	Data Handling: Registers and Bits, Data Handling, Arithmetic Functions, Closed Loop Control	**4**
13	Designing Systems: Program Development, Safe Systems, Commissioning, Fault Finding, System Documentation	**4**
14	Programs: Temperature Control, Valve Sequencing, Conveyor Belt Control….	**4**
15	PLC Process application: Data Measurements and Transducers, Process Responses and Transfer Functions, Process Controllers and Loop Tuning…	**6**
16	Advanced PLC topics and networks : Artificial Intelligence and PLC Systems, Fuzzy Logic, Local Area Networks, I/O Bus Networks	**6**
17	Final Assessment.	**2**

Textbook	• William Bolton, Programmable Logic Controllers, sixth edition 2015, Linacre House, Jordan Hill, Oxford OX2 8DP, UK • L.A. Bryan and E.A. Bryan, Programmable controllers: theory and implementation, 2nd edition 1997 by Industrial Text Company Published by Industrial Text Company.

Detailed of Practical Contents		
No.	**Contents**	**Hours**
1.	PLC Prerequisites :(Electrical basics, Industrial control)	**2**
2.	Addressing mode in PLC programming, basic logic programming in Instruction List and Structured Text languages	**2**
3.	Combination of Boolean operations and storing elements.	**2**
4.	Function blocks, edge-trigged functions, timers including switch-on delay, switchoff delay and pulse function	**2**

5.	Up counters, down counter, up/down counter with applications	**2**
6.	Programming structure - function calls and jump statements	**4**
7.	Analog to digital conversion and digital to analog conversion in PLC program.	**4**
8.	Conveyor belt station: basic sensors and actuators in manufacturing industry	**4**
9.	Sequence control development and programming.	**4**
10.	PLC network communication and PROFIBUS configuration	**4**
11.	Final Assessment.	**2**
Textbook	• S7-1200 Programmable controller - Industry Support Siemens 2017. • H. Jack, Automating Manufacturing Systems with PLCs, Lulu Press, Inc, 2010.	

Textbooks	• William Bolton, Programmable Logic Controllers, sixth edition 2015, Linacre House, Jordan Hill, Oxford OX2 8DP, UK • L.A. Bryan and E.A. Bryan, Programmable controllers: theory and implementation, 2nd edition 1997 by Industrial Text Company Published by Industrial Text Company.
	• S7-1200 Programmable controller - Industry Support Siemens 2017. • H. Jack, Automating Manufacturing Systems with PLCs, Lulu Press, Inc, 2010.

ELECTIVES 2

<table>
<tr><td>Department</td><td>Electronics Engineering</td><td>Major</td><td colspan="6">Industrial Electronics & Control</td></tr>
<tr><td>Course Name</td><td>Supervision of Industrial Processes</td><td>Course Code</td><td colspan="6">ELCC 412</td></tr>
<tr><td rowspan="2">Prerequisites</td><td rowspan="2">ELCC 435</td><td rowspan="2">Credit Hours
CRH</td><td colspan="2">3</td><td colspan="2">CTH</td><td colspan="2">5</td></tr>
<tr><td>L</td><td>2</td><td>P</td><td>2</td><td>T</td><td>1</td></tr>
<tr><td colspan="9">CRH: Credit Hours L: Lecture P: Practical T: Tutorial CTH: Contact Hours</td></tr>
</table>

Course Description :

This course reviews principles used on process supervision. The principles and methodologies of bond graph are introduced for analysis of industrial process supervision. The topics cover the bond graph model based qualitative FDI, Diagnostic and Bi-causal Bond Graphs for FDI, Actuator and Sensor Placement for Reconfiguration. Isolation of Structurally Non-Isolatable Faults, Multiple Fault Isolation Through Parameter Estimation, Fault Tolerant Control.

Topics :

- Introduction to process supervision
- Bond graph modelling in engineering systems: Bond Graph Theory and Methodology
- Model-based Control
- Bond Graph Model-based Qualitative FDI
- Application to a Steam Generator Process
- Diagnostic and Bicausal Bond Graphs for FDI
- Actuator and Sensor Placement for Reconfiguration
- Isolation of Structurally Non-isolatable Faults
- Multiple Fault Isolation Through Parameter Estimation
- Fault Tolerant Control

Experiments: If applicable, it will support the course topics

References:

- Arun K. Samantaray and Belkacem Ould Bouamama, Model-based Process Supervision, A Bond Graph Approach, 2008 Springer-Verlag London Limited.
- Wolfgang Borutzky , Bond Graph Methodology Development and Analysis of Multidisciplinary Dynamic System Models

Detailed of Theoretical Contents		
No.	**Contents**	**Hours**
1	Introduction to process supervision	4
2	Bond graph modeling in engineering systems: Bond Graph Theory and Methodology	4
3	Model-based Control	6
4	Bond Graph Model-based Qualitative FDI	4
5	Application to a Steam Generator Process	6
6	Diagnostic and Bicausal Bond Graphs for FDI	6
7	Actuator and Sensor Placement for Reconfiguration	4

8	Isolation of Structurally Non-Isolatable Faults	**4**
9	Multiple Fault Isolation Through Parameter Estimation	**4**
10	Fault Tolerant Control	**4**
11	Final Assessment.	**2**
Textbook	• Arun K. Samantaray and Belkacem Ould Bouamama, Model-based Process Supervision, A Bond Graph Approach, 2008 Springer-Verlag London Limited.	

Detailed of Practical Contents		
No.	**Contents**	**Hours**
1.	Presentation of Bond Graph Methodology	**2**
2.	Bond Graph Methodology with matlab simulink Application for Simple electrical network	**4**
3.	Advanced electrical systems network	**4**
4.	Simple linear mechanical	**2**
5.	Advanced linear mechanical	**4**
6.	system state-space representation	**4**
7.	Bond graph for an electric d.c. motor	**4**
8.	Bond graph First order control system	**4**
9.	Bond graph Second order control system	**2**
10.	Final Assessment.	**2**
Textbook	• Wolfgang Borutzky, Bond Graph Methodology Development and Analysis of Multidisciplinary Dynamic System Models.	

Textbooks	• Arun K. Samantaray and Belkacem Ould Bouamama, Model-based Process Supervision, A Bond Graph Approach, 2008 Springer-Verlag London Limited.
	• Wolfgang Borutzky, Bond Graph Methodology Development and Analysis of Multidisciplinary Dynamic System Models.

<table>
<tr><td>Department</td><td>Electronics Engineering</td><td>Major</td><td colspan="6">Industrial Electronics & Control</td></tr>
<tr><td>Course Name</td><td>Industrial Robotics</td><td>Course Code</td><td colspan="6">ELCC436</td></tr>
<tr><td rowspan="2">Prerequisites</td><td rowspan="2">EICC472</td><td rowspan="2">Credit Hours
CRH</td><td colspan="3">3</td><td colspan="2">CTH</td><td>5</td></tr>
<tr><td>L</td><td>2</td><td>P</td><td>2</td><td>T</td><td>1</td></tr>
<tr><td colspan="9">CRH: Credit Hours L: Lecture P: Practical T: Tutorial CTH: Contact Hours</td></tr>
</table>

Course Description :

Understand the different types of industrial robots, components, architecture and kinematic and dynamic modelling. Different methods of programming robots are discussed. Students will gain experience in handling and programming real industrial robots. They acquire skills about design, simulate and program robotic industrial applications. Thanks to simulation proposed work the student will get by himself different functionalities about a common and commercial IDE (Integrated Development Environment) for industrial robot programming.

The aim of the course is the introduction to Industrial Robotics from both theoretical and practical aspect. The importance of industrial applications and future.

Enable students to acquire basic knowledge of control and programming of industrial robots. For this we have tried to achieve a balance between the theoretical aspects, the study of the components that make up a robot (mechanical, computer and control), and applications (programming and implementation criteria of robotic systems).

Topics :

- Introduction
- Morphology and robotic technologies
- Control architecture of Industrial controllers
- Industrial Robotic Applications
- Kinematic Control
- Dynamic modelling
- Programming of robots
- Industrial implantation criteria and relevant issues

Experiments: If applicable, it will support the course topics

References:

- Craig, John J. Introduction to robotics: mechanics and control. Pearson Education. 2014
- Mark W. Spong, Seth Hutchinson and M. Vidyasagar, Robot Modeling and Control, John Wiley and Sons, 2006.
- Paul, Richard P. Robot manipulators, mathematics, programming, and control: the computer control of robot manipulators. MIT Press. 1981

Detailed of Theoretical Contents		
No.	**Contents**	**Hours**
1	Introduction, Definitions and terms, Historical evolution, Industrial Robot market and regulations, Statistics and trends in Industrial Robots Market	4
2	Morphology and robotic technologies, Structures and basic configurations, Review of main sub-systems: mechanical, Review of main sub-systems: actuators and drives,	6

	Review of main sub-systems: sensors	
3	Control architecture of Industrial controllers, Control architecture issues, Man-machine interface and communications, Controller functionalities.	**6**
4	Industrial Robotic Applications.	**6**
5	Kinematic Control, mathematical tools, Kinematic modeling, Direct and inverse kinematic problem formulation and resolution, Differential modeling,	**6**
6	Dynamic modeling, Dynamic Control problem formulation, Euler-Lagrange formulation, Direct and inverse dynamics main issues., Dynamic control issues	**6**
7	Programming of robots., Classification and Programming methods, Coordinate systems and spatial references	**6**
8	Industrial implantation criteria and relevant issues. Design aspects for Flexible Manufacturing Cells based on industrial robots and trends, Safety assurance in Industrial robots, Introduction to Collaborative Robots.	**6**
9	Final Assessment.	**2**

Textbook	• Craig, John J. Introduction to robotics: mechanics and control. Pearson Education. 2014 • Mark W. Spong, Seth Hutchinson and M. Vidyasagar, Robot Modeling and Control, John Wiley and Sons, 2006. • Paul, Richard P. Robot manipulators, mathematics, programming, and control: the computer control of robot manipulators. MIT Press. 1981

Detailed of Practical Contents		
No.	**Contents**	**Hours**
1.	• Operate the Teach Pendant • Navigate the Controller Software	**4**
2.	• Power up and Jog the Robot • Power down the Robot • Perform all Jog Methods	**6**
3.	• Execute production operations • Perform Frame setup • Create, modify and execute a material handling program	**6**
4.	• Understand all Programming Instructions • Understand all Positional Information (CARTESIAN vs. JOINT) • Understand all Motion Types (JOINT, LINEAR, CIRCULAR)	**6**
5.	• Create, set up and execute MACROs • Configure, Monitor, Force, and Simulate Input and Output Signals • Perform Standard Backup and restore programs and files	**6**
6.	Final Assessment.	**4**

Textbook	• Craig, John J. Introduction to robotics: mechanics and control. Pearson Education. 2014 • Mark W. Spong, Seth Hutchinson and M. Vidyasagar, Robot Modeling and Control, John Wiley and Sons, 2006. • Paul, Richard P. Robot manipulators, mathematics, programming, and control: the computer control of robot manipulators. MIT Press. 1981

Textbooks	• Craig, John J. Introduction to robotics: mechanics and control. Pearson Education. 2014 • Mark W. Spong, Seth Hutchinson and M. Vidyasagar, Robot Modeling and Control, John Wiley and Sons, 2006. • Paul, Richard P. Robot manipulators, mathematics, programming, and control: the computer control of robot manipulators. MIT Press. 1981
	• Industrial Robotics Technology programming and Applications - M.P.Groover, M.Weiss, R.N.Nagel, N.G.Odrey.

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Directorate General for Curricula

<table>
<tr><td>Department</td><td>Electronics Engineering</td><td>Major</td><td colspan="6">Industrial Electronics & Control</td></tr>
<tr><td>Course Name</td><td>Electric vehicle</td><td>Course Code</td><td colspan="6">ELCC463</td></tr>
<tr><td rowspan="2">Prerequisites</td><td rowspan="2">ELCC428</td><td rowspan="2">Credit Hours
CRH</td><td colspan="2">3</td><td colspan="2">CTH</td><td colspan="2">5</td></tr>
<tr><td>L</td><td>2</td><td>P</td><td>2</td><td>T</td><td>1</td></tr>
<tr><td colspan="9">CRH: Credit Hours L: Lecture P: Practical T: Tutorial CTH: Contact Hours</td></tr>
</table>

Course Description :

Conventional cars. Electric vehicle (EV) development history. Vehicle specifications. Architecture of Electrical vehicle system (two, three and four wheelers). Grid connected Electric Vehicle system. Hybrid vehicles with drive trains for series, parallel, combination. Automotive control area protocols. Types of motor used with special duty and constructions. Types of power storage used in Electrical vehicles. Power management system strategy and control strategy. Auxiliary electrical system in vehicles. Automotive steering systems. Automotive semiconductor devices, components and sensors. Automotive motor drives actuators and control. Testing of electric motor, controllers and hybrid electric vehicles. Safety components of Electrical vehicles. Passenger safety system.

Topics :

- Introduction to electric and hybrid vehicles
- Hybrid vehicle architectures
- Propulsion System Analysis
- Fuel cell vehicles
- Electric Motor Drive systems for EV/HEVs
- Power Electronic converters for electric and hybrid vehicles
- Energy Storage
- Energy management and control strategies
- More Electric Aircraft and More Electric Architectures

Experiments: If applicable, it will support the course topics

References:

- Chris Mi, M A Masrur, D W Gao, "Hybrid Electric Vehicles – Principles and applications with practical perspectives," Wiley, 2011.
- Iqbal Husain, "Electric and Hybrid Vehicles – Design Fundamentals," CRC Press, 2010
- John Miller, "Propulsion Systems for Hybrid Vehicles," Institute of Electrical Engineers, UK, 2004 (recommended)
- C.M. Jefferson & R.H. Barnard, "Hybrid Vehicle Propulsion," WIT Press, 2002.
- James Larminie and John Lowry, "Electric Vehicle Technology Explained, "Oxford Brookes University, Oxford, UK, 2003.

Detailed of Theoretical Contents		
No.	**Contents**	**Hours**
1	Introduction to electric and hybrid vehicles	**4**
2	Hybrid vehicle architectures: Series hybrid vehicle architectures- range extender and full hybrid systems , Parallel hybrid architectures , Plug-in hybrid architectures , Commercially available electric and hybrid vehicles	**4**
3	Propulsion System Analysis: Basic Mechanics of a Vehicle, Energy consumed in a vehicle, Powertrain component sizing, Vehicle Simulation , Driving cycles, Energy requirements , City cycle, highway cycle, and combined cycle	**6**
4	Fuel cell vehicles	**4**
5	Electric Motor Drive systems for EV/HEVs	**6**
6	Power Electronic converters for electric and hybrid vehicles	**6**
7	Energy Storage: Battery energy storage, Battery charging, Ultracapacitors	**6**
8	Energy management and control strategies: All electric range, Engine dominant blended strategy, Electric dominant strategy, Hybrid vehicle control strategies	**6**
9	More Electric Aircraft and More Electric Architectures	**4**
10	Final Assessment.	**2**
Textbook	• "Mechatronics," Sabri Cetinkunt, Wiley, 2006.	

Detailed of Practical Contents		
No.	**Contents**	**Hours**
1.	Electric Motor modeling and simulation	**4**
2.	Power Semiconductor AC and Dc motors drives	**8**
3.	Energy sources: Battery and Others	**6**
4.	Sensors	**4**
5.	Vehicle-to-Vehicle, Vehicle-to-Infrastructure Communications	**6**
6.	Final Assessment.	**4**
Textbook	• Chris Mi, M A Masrur, D W Gao, "Hybrid Electric Vehicles – Principles and applications with practical perspectives," Wiley, 2011. • John Miller, "Propulsion Systems for Hybrid Vehicles," Institute of Electrical Engineers, UK, 2004.	

Textbooks	• "Mechatronics," Sabri Cetinkunt, Wiley, 2006.
	• Chris Mi, M A Masrur, D W Gao, "Hybrid Electric Vehicles – Principles and applications with practical perspectives," Wiley, 2011. • John Miller, "Propulsion Systems for Hybrid Vehicles," Institute of Electrical Engineers, UK, 2004.

Appendix Laboratory Equipment, Workshops and Laboratories

No.	Laboratory name / workshop	Capacity of training	Number of trainers	Training courses benefiting from the laboratory / workshop / lab
1.	Circuits LAB	20	1	1. Circuits Analysis 2. Analog and Pulses circuits 3. Digital communication systems
2.	Electronic Circuits Design LAB	20	1	1. Embedded systems 2. Digital systems design
3.	Measurements Lab.	20	1	1. Sensors and Actuators 2. Computer Aided Design
5.	Industrial process Control Lab.	15	1	1. Industrial process control 2. Digital Control systems
6.	Power Electronics Lab.	15	1	1. Power Electronics 2. Electric drives
7.	Robotics LAB	15	1	1. Robotics 2. Artificial Intelligence 3. Industrial Robotics
8.	PLC LAB	15	1	1. PLC 2. Supervision of Industrial Processes
9.	Mechatronics LAB	15	1	1. Mechatronics 2. Electric Vehicles

List of Detailed Equipment for Each Laboratory, Workshop or Lab

Circuits LAB		
No.	**Product's Name**	**Quantity**
1.	Personal Computer	20
2.	Pspice package software	1
3.	Proteus-ISIS package software	1
4.	MATLAB package software	1
	معامل هذه المقررات تحتاج الى أجهزة كمبيوتر و نسخ من البرامج المستخدمة	

List of Detailed Equipment for Each Laboratory, Workshop or Lab

Electronic Circuits Design LAB		
No.	**Product's Name**	**Quantity**
1.	Function generator	12
2.	Measurement devices; voltmeter, ammeter and wattmeter	40
3.	Electronic components, diode and transistor	70
4.	Resistances, coils and capacitors	120
5.	Switches	50
6.	Oscilloscope	12
7.	COM3LAB unit	12
8.	Personal Computer	12
9.	XILINX ISE package software	1
10.	FPGA Boards	5
11.	ASIC Boards	5
12.	Personal Computer	20

List of Detailed Equipment for Each Laboratory, Workshop or Lab

Measurements Lab.		
No.	**Product's Name**	**Quantity**
1.	Function generator	12
2.	Electronic components, diode and transistor	60

3.	TBS1KB - Digital Oscilloscope from Tektronix .	12
4.	Measurement devices; voltmeter, ammeter and wattmeter	12
5.	LM35 Sensor	12
6.	PIR sensors	12
7.	Arduino Duemilanve or Uno board .	10
8.	Breadboard and connecting wires .	10
9.	Biosensors, RTD	20
10.	Personal Computer	20
11.	Electronic components, diode and transistor	120
12.	Resistances, coils and capacitors	120

List of Detailed Equipment for Each Laboratory, Workshop or Lab

Industrial process Control Lab.		
No.	**Product's Name**	**Quantity**
1.	Main control device	12
2.	Oscilloscope	12
3.	Control applications	6
4.	Control panel	6
5.	Fault diagnosis panel	6
6.	Amplifier unit	6
7.	COM3LAB unit	15

8.	Personal Computer	12

List of Detailed Equipment for Each Laboratory, Workshop or Lab

Power Electronics Lab.		
No.	**Product's Name**	**Quantity**
1.	Function generator	12
2.	Triac Module with protection 10A/500V	1
3.	Three-phase Control half & Full Converter	1
4.	Three-phase half & Fully Control Power Circuit	1
5.	Three Phase Inverter Stack for PWM Inverter, Semikron	1
6.	Single Phase Fully Control Bridge Converter with RL Load	1
7.	Gate Firing Circuit trainer	1
8.	Submicron Make Inverter	1
9.	BC Jone Chopper	1
10.	Oscilloscope	12
11.	Plug-in Board	12
12.	Measurement devices; voltmeter, ammeter and wattmeter	48
13.	Electronic components, diode and transistor	80
14.	Resistances, coils and capacitors	160
15.	Synchroscope	12
16.	AC/DC stabilizer	12
17.	Tacho-generator	12
18.	IGBT 1000V/10A	12

19.	Selenium rectifier 25V/10A	12
20.	Machine test system	12

List of Detailed Equipment for Each Laboratory, Workshop or Lab

Robotics LAB.		
No.	**Product's Name**	**Quantity**
1.	FANUC ARC Welding Robot Package	1
2.	DENSO Vision System	2
3.	DENSO Four Axis Robot -10kg payload	2
4.	FANUC Handling Robot Package -15kg payload	1
5.	DENSO Six Axis Articulated Robot - 5kg payload	2
6.	Tentram Robot - spindle type	1
7.	Modularised Conveyor System (U-Shape)	1
8.	Modularised Conveyor System (L-Shape)	1

List of Detailed Equipment for Each Laboratory, Workshop or Lab

PLC LAB.		
No.	**Product's Name**	**Quantity**
1.	PLC Siemens S7 control unit	12

2.	Personal Computer with STEP7 and TIA Portal software	12
3.	Analog I/O (0-10V) simulator with electronic voltage indicators	12
4.	Binary signal simulator	12
5.	Servo motor with permanent magnets	12
6.	PT100 temperature sensor with a z 0-10V transcoder	12
7.	Angle encoder	12
8.	Stepper motor	12
9.	Electronic proportional regulator,	12

List of Detailed Equipment for Each Laboratory, Workshop or Lab

Mechatronics LAB.		
No.	**Product's Name**	**Quantity**
1.	Analog and Digital Motor Control Teaching Set	2
2.	Transducer and Instrumentation Trainer kit	2
3.	Pneumatic and Electro Pneumatic Trainer Kit	2
4.	Advance Hydraulic Trainer	2
5.	Robotics Training System	2
6.	PLC Analog and Digital	6
7.	Ladder Software	6
8.	Mechanisms Trainer.	2
9.	Industrial control trainer	2
10.	PC work stations with Keithley-Metrabyte data acquisition cards	4
11.	digital oscilloscopes (Tektronix)	4
12.	function generators	10

13.	**Digital multi-meters**	10
14.	**Variable dual channel power supplies**	10
15.	**Soldering stations (Weller), tools, electronic components, integrated circuit chips, and breadboards**	10
16.	**KUKA Robot**	1
17.	**Microcontroller-TMDS3P701016A**	3

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