April

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King Fahd University of Petroleum and Minerals
Systems Engineering Department

Control and Instrumentation
Systems Engineering
(CISE)

Student Guide

SYSTEMS ENGINEERING DEPARTMENT

The Systems Engineering department offers two programs; Control and Instrumentation Systems Engineering (**CISE**) and Industrial and Systems Engineering (**ISE**). The first program covers analysis, design, and control of engineering systems. The second program focuses on the science and technology of industrial systems. It emphasizes the analysis and design of systems to produce goods and services efficiently. Particular attention is devoted to both the physical processes involved and the environment.

Both programs are offered in two options: the summer training option or Coop option. Coop programs are implemented in many technical universities worldwide. The student usually leaves the school for one or more semesters and joins a relevant industry, where he is exposed to real life applications of what has been taught in the school. This exposure provides the student with a more mature outlook and has a significant effect on his understanding of his role as a practicing engineer.

Vision of the Systems Engineering Department

Regional: To be the leader in the Arab region in the areas of Automation and Control, Industrial Engineering and Operations Research.

Global : To be recognized worldwide as a center of excellence in education and research in the areas of Automation and Control, Industrial Engineering and Operations Research.

Employment Opportunities

In Saudi Arabia, there is an abundance of capital but limited human resources. Automation provides ways of reducing manpower requirements in industry, agriculture, and other services. In fact, the leading petrochemical and related industries, desalination plants, and power systems within the Kingdom are already using modern automation techniques. Furthermore, Industrial Engineering and Operations Research are essential to any country embarked on an ambitious industrialization plan. Indeed, the effectiveness of an enterprise is heavily influenced by the physical arrangement of people, equipment, and materials. The industrial engineer designs many types of systems, from material handling systems to the layout of factories and offices; he determines storage needs and space requirements for manufacturing systems, provides work measurement services, calculates labor requirements, estimates the performance of proposed systems, and measures and improves the effectiveness of existing systems.

Graduates of both programs in the Systems Engineering Department are trained to use engineering principles in the solution of problems encountered in environments and situations where a quantitative basis for decision making is desirable.

Both programs provide the preparation necessary for admission to graduate programs in highly respected universities. Details of the two programs are given below.

Control and Instrumentation Systems Engineering

The primary thrust of this program is to graduate engineers who can carry out modern automation technology of industrial systems existing in all engineering disciplines such as the petrochemical industry, the steel industry, power systems, and the like, as well as non-industrial systems such as the automation of water supply systems and irrigation systems. This program emphasizes the analysis, design, synthesis, and optimization of control systems in order to provide the best means of controlling their dynamic behavior to produce favorable or specified outputs.

Mission:

The mission of the Control and Instrumentation Systems Engineering program is to provide high-quality education, research and community services in the areas of Control and Instrumentation. Specific components of the mission are:

- To provide a high-quality, state-of-the-art education in Control, Automation, and Instrumentation Engineering that produces professionals capable of performing jobs in their fields of specialization at the highest level of quality, competitiveness and professionalism.

- To conduct research that expands knowledge in the areas of Control, Automation, and Instrumentation and to provide a high-quality graduate program that gives students a solid foundation in their areas of specialty.
- To provide industry with a high-quality professional training, applied projects, and consultation services in the area of Control, Automation, and Instrumentation that is up-to-date and competitive worldwide.

CISE Program Educational Objectives (PEOs)

CISE graduates are expected to be, within a few years of graduation:

Objective 1: Successful professionals in CISE related areas
Objective 2: Leaders in their organizations
Objective 3: Pursuers of new knowledge to ever changing environment.

CISE Program Outcomes

The graduates of the CISE program should have the ability to:

a. apply knowledge of mathematics, science, and engineering;
b. design and conduct experiments, as well as analyze and interpret data;
c. design a system component, or process to meet desired needs within realistic constraints;
d. function as a member of a multi-disciplinary team;
e. identify, formulate, and solve Control and Instrumentation Systems Engineering problems;
f. understand and respect professional and ethical responsibility;
g. communicate effectively both orally and in writing;
h. understand the impact of engineering solutions in a global and societal context;
i. recognize the need for life-long learning, and an ability to engage in it;
j. have a knowledge of contemporary issues;
k. use up to date techniques, skills and tools of Control and Instrumentation Systems Engineering throughout their professional careers.

CISE Undergraduate Program

The degree requirements for the CISE program can be grouped into five broad sets of requirements as shown below.

(a) General Education Requirements: 52 credit hours

Arabic Studies	IAS 101, 201, 301	6
English Language	ENGL 101, 102, 214	9
Islamic Studies	IAS 111, 212, 322	6
Mathematics	MATH 101, 102, 201, 260	14
Chemistry	CHEM 101	4
Physics	PHYS 101, 102	8
Physical Education	PE 101, 102	2
Principles of Management	MGT 301	3

(b) General Engineering Fundamentals: 26 credit hours

ISE 205	Probability and Statistics	3
ISE 307	Engineering Economic Analysis	3
EE 201	Electrical Circuit I	4
ISE 402	Production Systems	3
ME 203	Thermodynamics I	3
ICS 103	Computer Programming in C	3
EE 203	Electronics I	4
CISE301	Numerical Methods	3

(c) Control and Instrumentation Systems Engineering Core Courses: 40 credit hours

CISE 201 Introduction to CISE	1
CISE 204 Design of Digital Systems	3
CISE 209 Introduction to Information Technology	2
CISE 302 Linear Control Systems	4
CISE 312 Instrumentation Engineering	3
CISE 313 Automation Devices and Electronics	3
CISE 315 Signals and Systems	3
CISE 316 Control Systems Design	3
CISE 318 Computer Control Systems	3
CISE 390 Seminars	0
CISE 412 Mechatronics	3
CISE 414 Embedded Systems Design	3
CISE 418 Industrial Process Control	3
CISE 438 Instrumentation for Process Control	3
CISE 490 Senior Design Project	3

(d) Electives

Students opting from the summer training stream are required to take 9 credit hours of CISE electives and 5 credit hours form KFUPM offering at large. Students opting from the cooperative training stream are required to take 6 credit hours of CISE electives and 2 credit hours form KFUPM offering at large.

CISE Elective Courses

CISE 421 Simulation and Control for Process Industry	
CISE 422 Intelligent Controllers	
CISE 423 Model Predictive Control	
CISE 424 Identification of Linear Systems	
CISE-431 Industrial Automation	
CISE 432 Digital Signal Processing	
CISE 433 Condition-based Maintenance	
CISE 434 Computer Numerical Control	
CISE 435 Distributed Computer Control Systems	
CISE 441 Linear Optimal Control	
CISE 442 Stochastic Control	
CISE 443 Introduction to Robust Control	
CISE 451 Introduction to Biomedical Engineering	
CISE 452 Theory of Stochastic Systems	
CISE 453 Methodology for Large Scale Systems	
CISE 454 Computer-Aided Manufacturing and Robotics	
CISE 455 Advanced Instrumentation	
CISE 456 Safety and Reliability of Control Systems	
CISE 457 Industrial Communication Systems	
CISE 439 Special Topics in Instrumentation	
CISE 449 Special Topics in Control	
CISE 459 Special Topics In Automation	

(e) Summer Training or Coop Training

Students taking the summer training option must spend 8 weeks of training in a facility approved by the department. This can be done in a summer term after completing a minimum of 85 credit hours. Each student needs to submit a report and makes an oral presentation. The CISE 399 (Summer training) is a zero credit pass/fail course.

For coop option, students must register the Coop training course, CISE 350 after completing a minimum of 85 credit hours, and have a minimum cumulative and major GPA of 2.0. Students are required to join a 28-week long industrial training program approved by the department. A total of 9 credit hours is allocated to CISE 351.

CONTROL AND INSTRUMENTATION SYSTEMS ENGINEERING CURRICULUM
(Summer Training Option)

COURSE		TITLE	LT	LB	CR	COURSE		TITLE	LT	LB	CR
Preparatory Year											
ENGL	001	Preparatory English I	15	5	8	ENGL	002	Preparatory English II	15	5	8
MATH	001	Preparatory Math I	3	1	4	MATH	002	Preparatory Math II	3	1	4
PYP	001	Prep. Physical Sciences	2	0	2	PYP	002	Prep. Computer Sciences	0	2	1
PYP	003	University Study Skills	0	2	1	ME	003	Prep. Eng. Technology	0	2	1
PE	001	Prep. Physical Educ. I	0	2	1	PE	002	Prep Physical Educ. II	0	2	1
			20	10	16				18	12	15
Total Credits required in Preparatory Program: 31											
First Year (Freshman)											
MATH	101	Calculus I	4	0	4	MATH	102	Calculus II	4	0	4
PHYS	101	General Physics I	3	3	4	PHYS	102	General Physics II	3	3	4
ENGL	101	Intro. to Acad. Discourse	3	0	3	ICS	103	Computer Programming	2	3	3
CHEM	101	General Chemistry I	3	4	4	ENGL	102	Intro. to Report Writing	3	0	3
IAS	101	Practical Grammar	2	0	2	IAS	111	Belief & its Consequences	2	0	2
PE	101	Physical Education I	0	2	1	PE	102	Physical Education II	0	2	1
			15	9	18				14	8	17
Second Year (Sophomore)											
MATH	201	Calculus III	3	0	3	MATH	260	Introduction to DE and LA.	3	0	3
CISE	201	Intro. to Control & Instrument.	1	0	1	CISE	204	Digital System Design	2	3	3
EE	202	Electric Circuit I	3	0	3	EE	203	Electronic I	3	3	4
EE	212	Electric Circuit Lab	0	3	1	ISE	205	Engineering Prob. & statistics	3	0	3
CISE	209	Introd. to Information Tech.	2	0	2	ENGL	214	Acad. & Prof. Comm.	3	0	3
ME	203	Thermodynamics I	3	0	3						
IAS	201	Objective Writing	2	0	2						
			14	3	15				14	6	16
Third Year (Junior)											
CISE	302	Linear Control Systems	3	3	4	CISE	312	Instrumentation Engineering	2	3	3
CISE	313	Auto. Devices and Electron	2	3	3	CISE	316	Control Systems Design	2	3	3
CISE	315	Signals and Systems	3	0	3	CISE	318	Computer Control Systems	2	3	3
CISE	301	Numerical Methods	3	0	3	CISE	4xx	CISE Elective I	x	x	3
IAS	301	Language Comm. Skill	2	0	2	ISE	402	Production Systems & Inven.	3	0	3
XX	xxx	Free Elective I	x	x	3	IAS	212	Professional Ethics	2	0	2
			13	6	18				11	9	17
Summer Session						CISE	399	**Summer Training**	**0**	**0**	**0**
Fourth Year (Senior)											
CISE	490	Senior Design Project	0	6	3	CISE	412	Mechatronics	2	3	3
CISE	4xx	CISE Elective II	x	x	3	CISE	414	Embedded Control Systems	2	3	3
CISE	4xx	CISE Elective III	x	x	3	CISE	418	Industrial Process Control	3	0	3
ISE	307	Engineering Economic Ana	3	0	3	CISE	438	Instrum. For Process Control	2	3	3
MGT	301	Principles of Management	3	0	3	IAS	322	Human Rights in Islam	2	0	2
CISE	390	Seminars	0	0	0						
XX	xxx	Free Elective II	x	x	2						
			6	6	17				11	9	14

Total Credits Required in Degree Program : 132

CONTROL AND INSTRUMENTATION SYSTEMS ENGINEERING CURRICULUM
(COOP Option)

COURSE		TITLE	LT	LB	CR	COURSE		TITLE	LT	LB	CR
Preparatory Year											
ENGL	001	Preparatory English I	15	5	8	ENGL	002	Preparatory English II	15	5	8
MATH	001	Preparatory Math I	3	1	4	MATH	002	Preparatory Math II	3	1	4
PYP	001	Prep. Physical Sciences	2	0	2	PYP	002	Prep. Computer Sciences	0	2	1
PYP	003	University Study Skills	0	2	1	ME	003	Prep. Eng. Technology	0	2	1
PE	001	Prep. Physical Educ. I	0	2	1	PE	002	Prep Physical Educ II	0	2	1
			20	10	16				18	12	15
Total Credits required in Preparatory Program: 31											
First Year (Freshman)											
MATH	101	Calculus I	4	0	4	MATH	102	Calculus II	4	0	4
PHYS	101	General Physics I	3	3	4	PHYS	102	General Physics II	3	3	4
ENGL	101	Intro. to Acad. Discourse	3	0	3	ICS	103	Computer Programming in C	2	3	3
CHEM	101	General Chemistry I	3	4	4	ENGL	102	Intro. to Report Writing	3	0	3
IAS	101	Practical Grammar	2	0	2	IAS	111	Belief & its Consequences	2	0	2
PE	101	Physical Education I	0	2	1	PE	102	Physical Education II	0	2	1
			15	9	18				14	8	17
Second Year (Sophomore)											
MATH	201	Calculus III	3	0	3	MATH	260	Introduction to DE and LA.	3	0	3
CISE	201	Intro. to Control & Instrument.	1	0	1	CISE	204	Digital System Design	2	3	3
EE	202	Electric Circuit I	3	0	3	EE	203	Electronic I	3	3	4
EE	212	Electric Circuit Lab	0	3	1	ISE	205	Engineering Prob. & statistics	3	0	3
CISE	209	Introd. to Information Tech	2	0	2	ENGL	214	Acad. & Prof. Comm.	3	0	3
ME	203	Thermodynamics I	3	0	3	IAS	301	Language Comm. Skill	2	0	2
IAS	201	Objective Writing	2	0	2						
IAS	212	Professional Ethics	2	0	2						
			16	3	17				16	6	18
Third Year (Junior)											
CISE	302	Linear Control Systems	3	3	4	CISE	312	Instrumentation Engineering	2	3	3
CISE	313	Auto. Devices and Electron	2	3	3	CISE	316	Control Systems Design	2	3	3
CISE	315	Signals and Systems	3	0	3	CISE	318	Computer Control Systems	2	3	3
CISE	301	Numerical Methods	3	0	3	CISE	4xx	CISE Elective I	x	x	3
IAS	322	Human Rights in Islam	2	0	2	ISE	402	Production Systems & Inven.	3	0	3
ISE	307	Engineering Economic Ana	3	0	3	CISE	390	Seminars	0	0	0
						CISE	490	Senior Design Project	0	6	3
			16	6	18				9	15	18
Summer Session						CISE	350	Cooperative Work Program	**0**	**0**	**0**
Fourth Year (Senior)											
CISE	351	Cooperative Work Program	0	0	9	CISE	412	Mechatronics	2	3	3
						CISE	414	Embedded Control Systems	2	3	3
						CISE	418	Industrial Process Control	3	0	3
						CISE	438	Instrum. For Process Control	2	3	3
						CISE	4xx	CISE Elective II	x	x	3
						XX	xxx	Free Elective I	x	x	2
			0	0	9				9	9	17

Total Credits Required in Degree Program : 132

List of CISE Courses

CISE 201 Introduction to Control and Instrumentation (1-0-1)
Definition and history of Automation. Social and economic dimension of Automation. Types and principles of automation systems, the hierarchy of control and instrumentation, career opportunities and scope of control and instrumentation profession. Skills, ethics, and design process. Case studies: Analysis of representative automation systems in the process industry, manufacturing, management, home and transportation.
Prerequisites : MATH 102.

CISE 204 Digital Systems Design (2-3-3)
Binary arithmetic. Boolean Algebra. Boolean functions and their simplification. Implementation of Boolean functions using logical gates, SSI, MSI, and LSI chips. Analysis and Design of Combinational circuits. Sequential Logic: Flip-Flops, Counters, and Registers. Analysis and Design of sequential circuits, Programmable Logic Devices, FPGA/PLD hardware. Analysis and Design using CAD software. Interfacing of digital electronics to control and instrumentation elements, such as relays, 24-volt signals, analog switches, and proximity switches.
Prerequisite : PHYS 102.
Note: Students who take EE200 for credit cannot take CISE 204 for credit

CISE 209 Introduction to Information Technology (2-0-2)
This course introduces the fundamentals of information technology and systems; their structure, and components. The course emphasizes the Enterprise applications of IT in improving the performance of business and industrial systems. In addition, the course introduces the current trends related to information technology, such as the Internet, E-commerce, and wireless communication. The course also gives an insight into security and ethical issues related to information exchange.
Prerequisite : Sophomore Standing

CISE 301 Numerical Methods (3-0-3)
Roots of nonlinear equations. Solutions of systems of linear algebraic equations. Numerical differentiation and integration. Interpolation. Extrapolation and approximation. Least squares approximation and regression analysis. Numerical solution of ordinary and partial differential equations. Introduction to error analysis. Engineering case studies.
Prerequisites : Math 201 and ICS 101, ICS 102,OR ICS103

CISE 302 Linear Control Systems (3-3-4)
Linear systems, Modeling of physical systems, Ordinary Differential equations models, Laplace Transform, transfer functions, block diagram manipulation. Open loop and closed loop systems, time domain analysis, response of systems to different test signals, Steady state analysis. Concept of stability, Routh-Hurwitz criteria, controller design. Laboratory activities include modeling, analysis and simulation of physical processes.
Prerequisite: MATH 260, EE 201

CISE 312 Instrumentation Engineering (2-3-3)
General measurement systems; SI units, errors in measurement systems, static and dynamic modeling of measurement systems, environmental effects, loading effects, noise in measurement systems, calibration, design of experiment, reliability of instrumentation systems. Typical measurement systems, displacement, velocity, and acceleration measurement. Pressure/Force measurement (capacitive, elastic, strain gauges, piezoelectric, electronic, weight scales, load cells). Temperature (elastic, expansion, resistive, thermocouple, IR, electronic). Analog signal conditioning and DC/AC bridges.
Prerequisite: EE203

CISE 313 Automation Devices and Electronics (2-3-3)

This is the first level of instrumentation and mechatronics. The course introduces the basic concepts of switching input and output devices, sensing devices, and how they are used in real life automation systems. The course is a prerequisite for the mechatronics course and for the advanced instrumentation course.
Prerequisite: EE203

CISE 315 Signals and Systems (3-0-3)
Basic models of continuous and discrete-time signals and systems. Basic characteristics of signals (energy, power, peak amplitude). Fourier analysis of continuous and discrete-time signals and systems. Basic concepts of signal sampling and reconstruction. Basic properties of Laplace and Z-transforms and concept of transfer function. Applications of signals and systems concepts to linear control systems and digital signal processing.

Prerequisites : Junior Standing.
Note: Students who take EE207 for credit cannot take CISE 315 for credit.

CISE 316 Control Systems Design (2-3-3)
Transient and Steady State analysis and design specifications. Root locus, Design using Root locus. Frequency Response Techniques, Bode plot, Nyquist plot, principle of Specifications and controller Design in the Frequency domain. State-space model, analysis of the state-space model, Controllability and Observability, pole placement, and robust Control.
Prerequisite: CISE 302 .

CISE 318 Computer Control Systems (2-3-3)
Elements of Computer Control Systems, A/D and D/A, Sampling theorem, signal conditioning, anti-alias filters, sensors, actuators. Discrete time systems, digital control design, digital PID control. Programmable logic controllers, computer control technology including distributed computer control, Fieldbus technology, and OLE for process control.

Prerequisite: CISE 302

CISE 350 Beginning Coop Program (0-0-0)
CISE 351 Cooperative Work Program (0-0-9)
The Cooperative Work Program accounts for nine (9) credit hours, involves either a team-based or a single student-based project that is geared toward an integrated application of several pieces of Systems Engineering knowledge learned by the student in his undergraduate education thus far. The co-op project must address technical aspects of the practice of Systems Engineering, including analysis, experimentation and design, by utilizing the problem-solving techniques covered in the various required (core) and elective courses offered at the Systems Engineering Department.
Prerequisite : Completion of 85 Credit Hours, and fulfillment of departmental requirements.

CISE 390 Seminars (0-0-0)
Improve students' ability in presenting technical work and introduce them to the knowledge of contemporary issues in their field of studies. The course features students' attendance to seminars, workshops, industrial visits, professional societal meetings, governmental agencies' conferences. Each student is required to present a written evidence for attending each of an adequate number of seminars and industrial visits at the end of the semester.
Prerequisites: Junior standing

CISE 399 Summer Training (0-0-0)
Students spend eight weeks in the industry, and submit a report and a presentation at the end of his summer training work.
Prerequisites : Junior standing

CISE 412 Mechatronics (2-3-3)
Mechatronics is the synergistic integration of mechanism, electronics, and computer control to achieve a functional system. Fundamentals of interfacing of modern mixed electrical, mechanical, and computers systems. Sensors, Signal Conditioning, Electro-Mechanical Actuation, Basic System Modeling, Essentials of Dynamic Systems, Data Acquisition and Virtual Instrumentation, and PC-Based and Embedded Controllers. Physical properties, mathematical modeling for computer simulation. Applications illustrated by numerically and experimentally generated results.

Prerequisite: CISE 313.

CISE 414 Embedded Control Systems (2-3-3)

Basic features microcontrollers, organization & architectural Features of Microprocessor & microcontroller, Basic organization, high level and assembly language conversion to machine level instruction. Basic fetch & execute cycle of a program. Instruction Set, basic operations and addressing modes, Assembly language programming, fast prototyping using high level languages. Typical Bus structure, I/O Control & interfacing to digital systems, Interfacing to various power switching devices. Interfacing Protocols. Sensors, A/D & D/A Converters, Analog signal conditioning Circuits. Pulse Width Modulation. Applications to Industrial Automation.

Prerequisites : CISE 204

CISE 418 Industrial Process Control (3-0-3)

Modeling of processes, Mass balance, and Energy balance, Models of representative processes, Dynamic response, and Linearization. Process identification using time and frequency domain techniques. Time delay, Smith predictor. Basic and advanced control strategies, e.g. PID, Feed forward, Internal model, and supervisory control. Time domain controller design, Controller tuning. Controller design in the frequency domain, Optimization Techniques and Supervisory Control. Case studies.

Prerequisite: CISE 302 .

CISE 421 Simulation and Control for Process Industry (3-0-3)
Review of the Fundamental laws, mathematical modeling; model and simulation of typical processes. Computer simulation tools, Virtual Instruments, MMI. Systems identification, IMC, Predictive control, DMC, Neural Network modeling and control. Students will work out simulation and control projects, using DYNSIM process dynamic simulation and SIMULINK, of typical processes, e.g., CSTR, Gas Surge Drum, Isothermal Chemical Reactor, Vaporizer, Binary Column, Heat Exchanger, etc.

Prerequisites: Senior Standing

CISE 422 Intelligent Controllers (3-0-3)

The course offers an introductory material to advanced control strategies such as fuzzy and neural network based controllers. The need for model–free control, Linguistic based control, foundations of fuzzy set theory. Main approaches of fuzzy control, design issues, fundamental of neural networks, neural networks architecture, neural networks based controller design. Application examples.
Prerequisites: Senior Standing

CISE 423 Model Predictive Control (3-0-3)

The course introduces the concept of model predictive control (MPC), their importance in process industry, implementation issues and application examples. The course covers: model based predictive control, generalized MPC, constrained MPC, some commercial MPC, issues in implementation in industrial control systems and case studies.
Prerequisites: CISE **316**

CISE 424 Identification of Linear Systems (3-0-3)

Dynamical systems and their mathematical models, random variables and signals, The system identification procedure. Guiding principles behind least-squares parameter estimation, statistical properties of estimates. Identification of the transfer function of linear systems in continuous time. Models for discrete-time linear systems: FIR, AR, ARX, ARMA. Various methods for recursive estimation. Experiments for data acquisition and their design.

Prerequisites: CISE 301 and CISE 318

CISE 431 Industrial Automation (3-0-3)

Industrial instrumentation: measurement techniques in industrial processes. Computer data acquisition. NC and CNC machine tools. Computer process interfacing and control. Feedback control systems. Group technology. Flexible manufacturing systems. Automated assembly. Industrial robots. Computer-aided inspection and testing. Automated factories. Case studies.
Prerequisites: Junior Standing

CISE 432 Digital Signal Processing (3-0-3)
Need for, advantages and basic structure of DSP systems. Basic concepts of discrete-time signals and systems. Z-Transform, discrete Fourier Transform (DFT) and frequency analysis of signals and systems. Efficient implementation of DFT: Fast Fourier Transform (FFT) algorithms. Implementation issues of discrete-time systems. Digital filter design techniques. Applications of DSP systems.
Prerequisites: CISE 315

CISE 433 Condition-based Maintenance (3-0-3)

Condition-based maintenance process. Data collection and Analysis process. Decision making. Condition-based monitoring components sensors and software programs. CMMS. Hazard and reliability functions. Models for CBM. Reliability improvement. Integration of CBM into the control design and operation. Engineering case studies.

Prerequisites: Junior Standing

CISE 434 Computer Numerical Control (3-0-3)

Review of DC motors, optical encoders, precision control of DC motors, Stepper motors, control of stepper motors, micro-step control, gearboxes, belts, motor torque and power sizing, programming motion using G-code. Basic structure and functions of milling machines and lathes. Motion simulation, CAD/CAM system. Robot arms construction, analysis, and motion programming. Case study of retrofitting conventional machines with Computer Numerical Control.

Prerequisites: CISE 318

CISE 435 Distributed Computer Control Systems (3-0-3)

Hierarchy of plant communication systems, field equipment, DCS systems, SCADA systems, Supervisory control and production control, Man-Machine Interface (MMI). Local area networks, OSI network architectures, serial communications, IEEE 802.xx standards, Local area networks for industrial applications, Field buses, Hart protocol, Foundation Field Bus, Profibus, CAN bus, etc. Smart instruments. Examples of industrial DCS systems.

Prerequisites: CISE 312

CISE 438 Instrumentation for Process Control (2-3-3)

Signal conditioning: 4-20 mA circuits, E/I transducers, bridges (AC and DC), design of bridges, operational amplifier circuits, filters (LP & HP), power supplies, reference voltages, analog multiplexer/ de-multiplexers. Data acquisition systems, SCADA Systems, interface cards, isolations, intrinsic safety, Nondestructive testing. LABVIEW, virtual instrumentation, Visual programming, and HMI, Plant network hierarchy, DCS, Data communications, smart transmitters, Field buses, and OPC. Process and Instrumentation diagrams.

Prerequisite: CISE312 , or instructor consent.

CISE 439 Special Topics in Instrumentation (3-0-3)

A course in an area of instrumentation reflecting current theory and practice.

Prerequisite: Approval of the Department.

CISE 441 Linear Optimal Control (3-0-3)

Review of state variable models, Review of basic matrix algebra, Static optimization, Formulation of optimal control problems, Principle of optimality. The linear quadratic regulator problem, properties of the algebraic Riccati equation (ARE) The minimum principle and time optimal control problems. Output feedback design. Homework assignments include design and simulation using MATLAB or other similar software packages.
Prerequisites: CISE 316

CISE 442 Stochastic Control (3-0-3)
Probability, Random Variables and distributions, correlation, MA, AR, and ARMA systems, power spectrum, Spectral factorization, Weiner-Hopf filter. Stochastic control systems, Minimum variance control, State-variable forms, Kalman filter, LQG feedback systems. Cases studies from published work.

Prerequisites: CISE 316

CISE 443 Introduction to Robust Control (3-0-3)

This course introduces the concepts of uncertainty and Modeling Error in Control System Analysis and Design. Review the basic methods and tools of Classical Control. Robust stabilization, Loop shaping, Introduction to H_∞ Optimal Control Analysis and Synthesis. Design examples.

Prerequisites: CISE 316

CISE 449 Special Topics in Control (3-0-3)

A course in an area of control reflecting current theory and practice.

Prerequisite: Approval of the Department.

CISE 451 Introduction to Biomedical Engineering (3-0-3)

Basics of anatomy and biological science. Fundamentals of engineering applications in biomedicine. Biomedical instrumentation and information technology, control and communication in biomedicine. eHealth and telemedicine.

Prerequisites: Senior Standing or Approval of the Department.

CISE 452 Theory of Stochastic Systems (3-0-3)
Review of basic Probability, Statistical Independence, Conditional Expectation and Characteristic Function. Introduction to Stochastic Processes, Stationarity and Ergodicity. Markov Chains and Poisson Processes. Linear Models of Continuous and Discrete Stochastic Processes. Engineering Applications.

Prerequisites: Senior Standing

CISE 453 Methodology for Large Scale Systems (3-0-3)

An overview of large-scale problems and the framework for Systems Engineering. Graphic tools for Systems Engineering. Interaction matrices and graphs, interpretive structure modeling. Spare matrix and decomposition techniques. Model reduction techniques. Case studies.

Prerequisites: Senior Standing

CISE 454 Computer-Aided Manufacturing and Robotics (2-3-3)
High volume discrete parts production systems. Fundamentals of CAD/CAM. Computers in manufacturing. Computer process monitoring. Systems for manufacturing support. Group technology and integrated manufacturing systems. Case studies for robots in industry. CAD/CAM using computer graphics laboratory.

Prerequisites: Senior Standing

CISE 455 Advanced Instrumentation (3-0-3)

Micro-machined sensors, Fiber optical sensors, Gas chromatography, Gas detectors, Environment monitoring systems, NMR, Soft-sensing techniques.

Prerequisites: CISE 312

CISE 456 Safety and Reliability of Control Systems (3-0-3)

DCS systems, Intrinsic safety, Emergency shutdown ESD systems, reliability of instruments and control systems, MTBF, Redundant systems, Safety standards,. Classification of industrial process, Safety integrity levels (SIL), Quantitative risk assessment (QRA), Safety and control networks, Fieldbus for safety systems, Cost benefit analysis, Best practices.

Prerequisites: Junior Standing

CISE 457 Industrial Communication Systems (3-0-3)

The course introduces the students to the latest trends in industrial communications systems in a practical theme. The course starts by previewing the main topics in communications systems such as modulation and coding. The course

then covers the main communication network standards used in industry. The course covers mainly all data layers from the field instruments to the TCP/IP and world-wide web and even latest wireless data exchange techniques. Case studies of industrial DCS and CIM and their integration with the enterprise networks.

Prerequisite: CISE 318 , or approval of Department.

CISE 459 Special Topics in Automation (3-0-3)

A course in an area of automation reflecting current theory and practice.

Prerequisite: Approval of the Department.

CISE 490 Senior Design Project (0-9-3)

A design course that draws upon various components of the undergraduate curriculum. The project typically contains problem definition, analysis, evaluation and selection of alternatives. Real life applications are emphasized where appropriate constraints are considered. Oral presentation and a report are essential for course completion. The work should be supervised by faculty member(s). Team projects are acceptable wherever appropriate.
Prerequisite: CISE 390.