Fourth (4th) Year
Semesters 07/08

CONTROL Option

Course title: *EE322 Digital Systems II* X
Lec./Rec./Lab.: *3/0/3 Hours per week*
Class: *E06.*

Course Outline

1- TIMING CIRCUITS
- 1.1- Importance of timing circuits
- 1.2- The 555 internal configuration
- 1.3- The 555 as a monostable
- 1.4- The 555 as an astable: -with DC 50-100%, -with DC 0-100%
- 1.5- The 74121 TTL one-shot
- 1.6- The Schmitt trigger

2- MSI COUNTERS & APPLICATIONS
- 2.1- Unidirectional counters
- 2.2- Programmable bi-directional counters
- 2.3- Design of modulo-N counter using Ics.
- 2.4- Applications

3- MSI REGISTERS & APPLICATIONS
- 3.1- Design of shift registers: -SISO, -SIPO, -PISO, -PIPO
- 3.2- The bi-directional shift register.
- 3.3- The universal shift register
- 3.4- Applications

4- STANDARD COMBINATIONAL MODULES
- 4.1- Binary decoders
- 4.2- Binary encoders
- 4.3- Priority encoders
- 4.4- Multiplexers and Vector Multiplexers
- 4.5- Demultiplexers and Vector Demultiplexers
- 4.6- ROMs
- 4.7- PALs
- 4.8- PLAs
- 4.9- Implementation of Boolean expressions using: -Decoders, -Multiplexers, -ROMs, PALs, PLAs
- 4.10- Comparison of different approaches
- 4.11- Arbitrary waveform generation
- 4.12- Keyboard encoding

5- SEMICONDUCTOR MEMORIES
- 5.1- Tri-state devices and principle
- 5.2- Definitions
- 5.3- A 1-bit memory cell: -Static, - dynamic.
- 5.4- Ram architecture:
- 5.5- ROM: -PROM, -EPROM, -EEPROM
- 5.6- Applications:

6- OPTOELECTRONIC DISPLAYS & CHARACTER GENERATOR
- 6.1- Numerical displays
- 6.2- Ripple blanking
- 6.3- Alphanumeric displays
- 6.4- Applications

7- SYNCHRONOUS SEQUENTIAL SYSTEMS

7.1- Sequential systems specifications
7.2- State diagram
7.3- Mealy and Moore architecture model
7.4- Analysis of synchronous sequential systems
7.5- Design of synchronous sequential systems
7.6- Distinguishable and equivalent states
7.7- State minimization procedure

8- DAC & ADC CONVERTERS

8.1- Amplitude quantization
8.2- Time quantization (Sampling)
8.3- Digital-to-Analog Converter
8.4- Analog-to-Digital Converter

LAB. EXPERIMENTS

1- Counters
2- Shift registers
3- Encoders/decoders, mux/demux
4- Timing circuits
5- Memory devices
6- A/D and D/A conversion

Course title: *EE332 Power Electronics*
Lec./Rec./Lab.: *03/00/03 hours per a week*
Class: *E06*

Course Outline

1-INTRODUCTION TO POWER ELECTRONICS

1.1-Definition of power electronics
1.2-Types of power switches used
1.3-Converter terminology
1.4-Power frequency domains

2-POWER DEVICES

2.1-Power rectifier: Thyristor, TRIAC, gate turn-off switch ;Development of the operation from the Schottkey diode and tow transistor analogy
2.2-Major characteristics and parameters of the devices with particular reference to available device and data sheets
2.3-Thermal performance under normal and fault conditions: this will involve work on heat sinks
2.4-Gating requirements

3-POWER RECTIFICATION

3.1-Single and Three-phase half-wave; full wave center-tapped and bridge circuits
3.2-Development of circuit operation and complete circuit waveforms with R; R & L; back emf loads
3.3-Prediction of differences between ideal and practical circuits
3.4-Operation and use of freewheeling diode
3.5-Summarize the application areas of each circuit and the circuit performance (Vo AVE, Vo RMS., P_{out}, Power factor, ripple factor, harmonic content)

4-CONTROLLED RECTIFICATION PRINCIPLES

4.1-Repeat section 3 with the power rectifier replaced by combinations of power rectifiers and silicon controlled rectifiers
4.2-Phase control principles and the problems of gating ; radio frequency interference; switching transients
4.3-Properties and selection of snubber circuits
4.4-Use of graphical performance curves

5-AC VOLTAGE CONTROL PRINCIPLES

5.1-Principles of phase control: tap-changing and integral cycle control (zero voltage switching)
5.2-Comparison of operational characteristics of the systems
5.3-Use of graphical performance curves for voltage; power and harmonic content
5.4-Compare the merits of the TRIAC with the inverse-parallel SCR arrangement

7- a-Investigate the performance of DC commutation circuits
b-Evaluate the performance of DC chopper

8-Evaluate the performance of basic parallel inverter circuits

9-Light control circuits : investigate:
a-DC flasher
b-AC flasher
c-Ring counter
d-Chaser
e-Lamp dimming systems
Record all circuit waveforms

10-Motor speed control
Open and closed systems for the control of the DC motor and the universal motor

Course Title : EE402 Linear systems II: Discrete-time Signals and Systems ×
Lec. / Rec. / Lab. : 03 / 00 / 00 Hours per week
Class: E07

Course Outline

Chapter 1: Discrete-time Signals and systems
- 1.1: Review of the properties of discrete time signals
- 1.2: Basic discrete-time signals
- 1.3: Brief Review of the properties of continuous time Linear time- invariant systems

Chapter 2: Discrete -time Linear time-invariant systems
- 2.1: Representation of signals in terms of impulses
- 2.2: Discrete-time LTI systems: The convolution Sum
- 2.3: Properties of the convolution operator
- 2.4: Properties of Linear Time-Invariant Systems:
  - Impulse response and step response
  - Causality, stability, and interconnections of discrete- time LTI systems
- 2.5: Discrete- time systems described by constant coefficients Difference equations:
- 2.6: Poles and zeros of discrete-time LTI systems
- 2.8: Determination of the complete response of LTI systems to given input signals: Methods of solving linear constant coefficients Difference equations
- 2.9: Block-Diagram Representations of LTI systems Described by linear constant coefficients difference equations

Chapter 3: Fourier Analysis for discrete-time signals and systems
- 3.1: Response of discrete-time LTI systems to complex exponentials
- 3.2: Discrete-time Fourier series representation of periodic signals
- 3.3: Discrete-time Fourier transform of aperiodic signals
- 3.4: Discrete-time Fourier transform of periodic signals
- 3.5: Properties of the Discrete -time Fourier Transform and the inverse Fourier Transform
- 3.6: Polar representation of Discrete-time Fourier transform
- 3.7: The frequency response of systems characterised by linear constant-coefficient difference equations
- 3.8: First-Order and Second-Order systems
- 3.9: Determination of the Transfer function, the impulse response, and steady state response from the frequency response

Chapter 4: The Z-Transform
- 4.1: Definition of the Z-transform of a discrete-time signal
- 4.2: The region of convergence of the Z-transform
- 4.3: The Inverse Z-transform
- 4.4: Geometric evaluation of the Fourier Transform from the Pole-Zero Plot
- 4.5: Properties of the Z-Transform
- 4.6: Analysis and characterisation of LTI systems using Z-transform
- 4.7: The unilateral Z-transform

Chapter 5: Sampling of continuous time signals

- 5.1: Representation of a continuous-time signal by its samples: The sampling theorem
- 5.2: Reconstruction of a signal from its samples using interpolation
- 5.3: Sampling in the frequency domain
- 5.4: Transformations between continuous -time and discrete -time systems

Chapter 6: Introduction to State variable analysis of linear systems

- 6.1: Derivation of the state variable model of an LTI system: Canonical and Diagonal forms
- 6.2: Relation between Discrete state model and the finite difference equation
- 6.3: Discrete state Controllability
- 6.4: Discrete state observability

Course title: *EE421 Computer Architecture*
Lec./Rec./Lab.: *3/0/0 Hours per a week*
Class: *E07.*

Course Outline

1-BASIC COMP UTER ARCHITECTURE
- 1.1-Introduction to assembly language
- 1.2-Introduction to computer architecture
- 1.3-Basic building blocks of computer design
- 1.4-Bus structures
- 1.5-Data representation: - data types, - floating-point arithmetic

2- REGISTER TRANSFER LANGUAGE

3- ESSENTIALS OF COMPUTER SOFTWARE
- 3.1-Instruction format
- 3.2-VAX instruction format
- 3.3-Addressing modes
- 3.4-Example programs

4- CPU STRUCTURE
- 4.1-Basic CPU architecture
- 4.2-CPU operation
- 4.3-Implementing complete instructions
- 4.4-RISC

5- THE ALU STRUCTURE AND OPERATION
- 5.1-Computer addition and subtraction
- 5.2-Multiplication and division
- 5.3-Shift instructions
- 5.4-Bit manipulation

6- MICROPROGRAMMING
- 6.1-What is microprogramming ?
- 6.2-Microprogramming examples
- 6.3-Microprogram branching

7- MEMORY STRUCTURE
- 7.1-Memory devices
- 7.2-Memory organization: - bank, - interleaved
- 7.3-Cache memory
- 7.4-Mapping functions: - direct mapping, - associative mapping, - block-set associative mapping
- 7.5-Virtual memory

8- THE I/O SYSTEM
- 8.1-Addressing I/O devices
- 8.2-Data transfer: - Program-controlled I/O, - DMA, - I/O channel
- 8.3-Interrupt-driven I/O
- 8.4-Queue I/O
- 8.5-Advanced I/O devices: - disk drives, -tapes

9- MICROPROCESSORS
- 9.1- Microprocessors characteristics
- 9.2- General microprocessor architecture
- 9.3- The Motorola family
- 9.4- The Intel family

10- LARGE SYSTEM ARCHITECTURE
- 10.1- Architecture classification:
- 10.2- Pipeline structures
- 10.3- Array structures
- 10.4- Multiprocessors

11- FAULT-TOLERANT COMPUTER ARCHITECTURE
- 11.1- Reliability measures
- 11.2- Hardware redundancy
- 11.3- Static, dynamic, hybrid

Course Title: *EE434 Thermal Exchanges*
Lec./Rec./Lab. : *3/0/0 Hours per week*
Class: *E08*

Course Outline

1-INTRODUCTION

1.1-Engeneering area of Heat Transfer and Thermodynamics
1.2-Conduction Heat Transfer
1.3-Cónduction and the Fourier Law
1.4-Convection Heat Transfer and the Newton's Law of cooling
1.5-radiation Heat Transfer and the Stephan-Boltzman Law

2- ONE DIMENSIONAL STEADY STATE HEAT CONDUCTION

2.1-The General Heat Conduction Equation
2.2-The Plane Wall: Fixed Surface Temperature
2.3-Radial Systems -Cylinders
2.4-Composite Multi-Layer Plane Wall, Thermal Resistance
2.5-The Overall Heat-Transfer Coefficient
2.7-Heat-Source Systems
2.7-Cylinder with Heat Sources
2.8-Conduction-Convection Systems
2.9-Thermal Contact Resistance
2.10-Heat Transfer From Fins

3- MULTIPLE-DIMENSIONSONAL STEADY STATE CONDUCTION

3.1- Introduction
3.2-Analytical Solution
3.3-Graphical analysis
3.4-The Conduction Shape Factor
3.5-Numerical Method of Analysis
3.5-Numerical Formulation in Terms of Resistance Elements
3.7-Electrical Analogy for two-dimensional Conduction

4-UNSTEADY-STATE CONDUCTION

4.1-Introduction
4.2-Transient Heat Flow in Systems with negligible Internal resistance
4.3-Transient Heat Flow in a Semi-Infinite Solid
4.4-Convection Boundary Conditions
4.5-Multi Dimensional Systems
4.6-Transient Numerical Method

5-PRINCIPLES OF CONVECTION

5.1-Dimentional analysis, the Nusselt Number
5.2-Forced Convection
5.3-Natural and Free Convection
5.4-Reynolds Analogy and the Stalon number, Pumping Power

Course title: *EE452 Linear Control Systems*
Lec./Rec./Lab.: *3/0/3 Hours per week*
Class: *E07*

Course Outline

1- INTRODUCTION TO CONTROL SYSTEMS
- 1.1-History of Automatic Control
- 1.2-Control Engineering Practice
- 1.3-Examples of Modern Control Systems

2- SYSTEM REPRESENTATION
- 2.1-Differential Equations of Physical Systems
- 2.2-Linear Approximations Of Physical Systems
- 2.3-The Laplace transform
- 2.4-The transfer function of Linear systems
- 2.5-Block Diagram models
- 2.6-Signal-Flow graph models
- 2.7-Computer Analysis of Control Systems

3- FEEDBACK CONTROL SYSTEM CHARACTERISTICS
- 3.1-Open-Loop and Closed-Loop Control Systems
- 3.2-Sensitivity of Control Systems to Parameter Variations
- 3.3-Control of Transient Response of Control Systems
- 3.4-Disturbance signals in a Feedback Control System
- 3.5-Steady-State Error

4- THE PERFORMANCE OF FEEDBACK CONTROL SYSTEMS
- 4.1-Time-Domain Performance Specifications
- 4.2-The s-Plane Root Location and the Transient Response
- 4.3-The Steady-State Error
- 4.4-Performance Indices
- 4.5-Second-Order System
- 4.6-The Simplification of Linear Systems

5-THE STABILITY OF LINEAR FEEDBACK SYSTEMS
- 5.1-The Concept of Stability
- 5.2-The Routh-Hurwitz Stability Criterion
- 5.3-The Relative Stability of Feedback Control Systems

6- THE ROOT-LOCUS METHOD
- 6.1-The Root Locus Concept
- 6.2-The Root Locus Procedure
- 6.3-Parameter Design By The Root Locus Method
- 6.4-Sensitivity and The Root Locus

7- FREQUENCY RESPONSE METHODS

7.1-Frequency Response Plots
7.2-Performance Specifications in the Frequency Domain
7.3-Log Magnitude and Phase Diagrams

8- NYQUIST METHOD

8.1-Mapping of Contours in S-Plane
8.2-The Nyquist Criterion
8.3-The Closed-Loop Frequency Response
8.4-The Stability of Control Systems with Time Delays

9-THE DESIGN AND COMPENSATION OF FEEDBACK CONTROL SYSTEMS

9.1-Approaches to Compensation
9.2-Cascade Compensation Network
9.3-System Compensation on the Bode Diagrams Using the Phase-Lead and Phase-lag networks
9.4-Compensation on the s-Plane
9.5- Compensation on the Bode Diagrams Using Analytical and Computer Methods
9.6-The Design of Control Systems in the time Domain
9.7-State-Variable Feedback

LAB. EXPERIMENTS

1- Familiarization
2- Error channel investigation
3- Simple position control system
4- Closed-loop position control systems
5- Simple speed control system
6- Deadband and step response
7- Velocity feedback

Course title: *EE403 Nonlinear Systems*
Lec./Rec./Lab.: *3/0/0 Hours per week*
Class: *E08.*

Course Outline

1- MATHEMATICAL PRELIMINARIES:

- 1.1- Metric spaces
- 1.2- Banach spaces
- 1.3- Hilbert spaces
- 1.4- Contraction mapping theorem, existence and uniqueness of solutions to differential equations

2- THE STATE-SPACE APPROACH TO SYSTEMS ANALYSIS AND SOLUTION OF THE LINEAR STATE EQUATIONS.

- 2.1- System state equations
- 2.2- Normal and canonical forms
- 2.3- The solution of the linear state equation
- 2.4- Controllability and observability of LTI systems

3- SECOND ORDER SYSTEMS

- 3.1- Linear systems and phase portrait
- 3.2- Nonlinear systems
  - a- Linearization method
  - b- Graphical Euler method
  - c- Isocline method
  - d- Vector field method
- 3.3- Periodic solutions and limit cycles: Bendixon's theorem

4- DESCRIBING FUNCTION ANALYSIS OF NONLINEAR CONTROL SYSTEM

- 4.1- The describing function method
  - a- A general formulation of the describing function method for zero-memory type nonlinearities
  - b- Describing functions for memory type nonlinearities
- 4.2- Describing function analysis: stability of sustained oscillation and limit cycles
- 4.3- Justification of the describing function

5- STABILITY IN THE SENSE OF LIAPUNOV

- 5.1- Definitions
- 5.2- First and second method of Liapunov
- 5.3- Stability analysis of linear systems
- 5.4- Estimating the transient response behavior of dynamic systems
- 5.5- Stability analysis of nonlinear systems
  - a- Krasovski's method
  - b- Schultz-Gibson's variable gradient method.

6- CONSTRUCTION OF LIAPUNOV FUNCTION

7- APPLICATION OF LIAPUNOV APPROACH TO LINEAR SYSTEMS

E422 Microprocessors System Design

Textbook: The Z-80 Microprocesor
Ramesh S. Gaonkar, 3rd Edition.

Lec./Lab./Credit Hours: (3, 3, 4)

Topics

1. Introduction to Microprocessors
   - Microprocessor History and Evolution
   - Microcomputers and Large Frame Systems
   - Microprocessor-Based Systems Architecture

2. Microprocessor Architecture
   - General computer architecture
   - The MPU
   - Input/Output
   - A Comparison of Typical Microprocessors

3. The Z-80 Microprocessor
   - MPU Signal Description
   - Programming Model
   - Memory and I/O Interfacing

4. Z-80 Assembly Language Programming
   - Instruction Set and Machine Language Programming
   - Addressing Modes
   - Introduction to Z-80 Assembly Language and Programming
   - Assemblers and Software Development Tools
   - Stacks and Subroutines
   - Programming Examples

5. Memory Interfacing
   - MPU Timing Diagrams
   - Timing Considerations of Memory Devices
   - Memory Organization and Address Decoding
   - Memory Expansion
   - MT-80AZ Memory Map

6. I/O Interfacing
   - Interrupt Handling Techniques
   - Simple Input/Output Devices
   - I/O Device selection
   - Programmable Interface Devices:
     - Intel PPI 8255
     - Zilog Parallel Input Output (PIO)
     - Zilog Counter Timer Circuit (CTC)

7. Direct Memory Access
   - DMA Concepts
   - The Z-80 DMA Structure

8. Microprocessor-Based Communications
   - Introduction to Digital Communication
   - Serial Communication Interface Adapter: The MC6850
   - RS232 C Interface Standard
   - Modems

9. Designing Microprocessor-Based Systems
   - Application Examples

10. Trends in Microprocessors Technology

LAB. EXPERIMENTS

1- Getting Familiar with the MT-80AZ Microcomputer
2- Arithmetic Operations
3- Data Conversion and Manipulations
4- Event Counting and Interrupt Handling
5- I/O Interfacing through the 8255 PPI
6- Waveform Generation (DACs Interfacing)
7- Data Acquisition (ADC Interfacing)

Course title: *EE431 Power systems*
Lec./Rec./Lab. : *3/0/3 Hours per week*
Class: *E07*

Course Outline

1-BASIC CONCEPTS

2-SERIES IMPEDANCE OF TRANSMISSION LINES

2.1-Types of Conductors
2.2-Resistance
2.3-The Influence of Skin Effect on Resistance
2.4-Tabulated Resistance Values
2.5-Inductance of a Conductor Due to Internal Flux
2.6-Inductance of a Single-Phase Tow-Wire Line
2.7-Inductance Of composite-Conductor Lines
2.8-Inductance of Three-Phase Lines With Equilateral and Unsymetrical Spacing
2.9-Bundled Conductors
2.10-Parallel-Circuit Three-Phase

3-CAPACITANCE OF TRANSMISSION LINES

3.1-Electric Field of a Long Straight Conductor
3.2-Capacitance of a two-Wire Line
3.3-Capacitance of a Three-phase Line With Equilateral and Unsymetrical Spacing
3.4-Effect of Earth on the Capacitance of Three-Phase Transmission Lines
3.5-Bundled Conductors
3.6-Parallel-Circuit Three-Phase Lines

4-CURRENT AND VOLTAGE RELATIONS ON A TRANSMISSION LINE

4.1-Representation of Lines
4.2-The Short Transmission lines
4.3-The Medium-Length Line
4.4-The Long Transmission Line
4.5-The Equivalent Circuit of a Long Line
4.6-Power Flow through a Transmission Line

5-REPRESENTATION OF POWER SYSTEMS

5.1-The One-Line Diagram
5.2-The Impedance and Reactance Diagrams
5.3-Per-Unit Quantities
5.4-Selection of Base for Per-Unit Quantities
5.5-Per-unit Impedances of Three-Winding Transformers

6-NETWORK EQUATIONS AND SOLUTIONS

6.1-Node Elimination by Star-Mesh Transformations
6.2-Equivalence of Sources
6.3-Node Equations
6.4-Node Elimination by Matrix Algebra
6.5-The Bus Admittance and Impedance Matrices

7-LOAD-FLOW STUDIES

7.1-Data for Load-Flow Studies
7.2-The Gauss-Seidel Method
7.3-The Newton-Raphson Method
7.4-Digital-Computer Programs

8-SOME PRINCIPLES OF LOAD-FLOW CONTROL

8.1-The Synchronous Machine
8.2-The Effect of Synchronous Machine Excitation
8.3-The Power Angle of a Synchronous Machine
8.4-The Specification of Bus Voltages
8.5-Capacitor Banks
8.6-Control by Transformers

9-ECONOMIC OPERATION OF POWER SYSTEMS

9.1-Distribution of Load between Units within a Plant
9.2-Transmission Loss as a Function of Plant Generation
9.3-Calculating of Load between Plants
9.4-Alternate Methods of Computing Penalty Factors
9.5-Automatic Load Dispatching

LAB. EXPERIMENTS

1-Safty and the power supply
2-Power Flow and Voltage Regulation of a Simple Transmission Line
3-Phase Angle and Voltage Drop between Sender and Receiver
4-Parameters which affect Real and Reactive Power Flow
5-Parallel Lines, Transformers and Power-Handling Capacity
6-The Synchronous Motor and Long High Voltage Lines
7-Transmission Line Networks and the Buck-Boost, Phase-Shift Transformer
8-Power System Transients

Course title: *EE453 Process Control and Instrumentation.*

Lec./Rec./Lab.: *3/0/3*

Course Outline

1- GENERALITIES OF INSTRUMENTATION & PROCESS CONTROL

- 1.1- Open loop and Closed loop process
- 1.2- Terminology used in dynamics and Control
- 1.3- Elements of process Control
- 1.4- Evaluation of process Control
- 1.5- Analog Control
- 1.6- Digital Control

2- ANALOG SIGNAL CONDITIONING (A.S.C.)

- 2.1- Introduction
- 2.2- General type of A.S.C.
- 2.3- Operational Amplifiers (Op-Amps)
- 2.4- Op-Amps Circuits in Instrumentation
- 2.5- Power Interface.

3- DIGITAL SIGNAL CONDITIONING

- 3.1- Converters
- 3.2- D.A.C: applications, structure and characteristics.
- 3.3- A.D.C: applications, structure and characteristics.
- 3.4- Data Acquisition Systems

4- TRANSDUCERS

- 4.1- Thermal transducer: R.T.D., semiconductors, thermistors.
- 4.2- Thermocouples: principles, types and applications.
- 4.3- Liquid-expansion thermometers, bimetal strips.
- 4.4- Mechanical transducers
- 4.5- Displacement, location and position transducers
- 4.6- Capacitive and inductive
- 4.7- Linear variable differential transformer (L.V.D.T)
- 4.8- Level transducers
- 4.9- Stress-strain measurement.
- 4.10- Strain gage principles
- 4.11- Motion transducers
- 4.12- Accelerometer principles, types
- 4.13- Optical transducers.

5 ELEMENTS IN DIGITAL CONTROL

- 5.1- Control System Parameters
- 5.2- Control Operating Modes
  - Two-position mode
  - Multi-position mode
  - Floating mode
  - Integral mode
  - Proportional mode
  - Derivative mode
- 5.3- Composite control modes (PI mode, PD mode, PID mode)

6- APPLICATION TO TEMPERATURE CONTROL

- 6.1- Hardware set up
- 6.2- Software set up

Course title: *EE454 Digital Control Systems I*
Lec./Rec./Lab.: *3/0/0 Hours per week*
Class: *E08*

Course Outline

1- INTRODUCTION TO DISCRETE TIME CONTROL SYSTEMS
- 1.1-Basic Elements of a Discrete-Data Control System
- 1.2-Advantages of Discrete-Data Control Systems
- 1.3-Examples of Discrete-Data and Digital Control Systems

2- REVIEW OF THE Z TRANSFORM
- 2.1-Motivation of Using Z-Transform
- 2.2-Relationship between the Laplace Transform and the Z-Transform
- 2.3-Relationship Between the S-plane and the Z-plane
  - 2.3.1-Mapping of the Primary strip
  - 2.3.2-Mapping of the Constant Frequency
  - 2.3.3- Mapping of the Constant Damping -Coefficient Loci
  - 2.3.4- Mapping of the Constant Damping-Ratio Loci
- 2.4-The inverse Z-transform
- 2.5-The delayed Z-transform and the Modified Z-transform

3-TRANSFER FUNCTIONS, BLOCK DIAGRAMS, AND SIGNAL FLOW GRAPHS
- 3.1-The Pulse transfer Function and the Z-Transfer Function
- 3.2-Pulse Transfer Function of the Zero-Order Hold and the Relation between G(s) and G(z)
- 3.3-Closed-Loop Systems
  - 3.3.1-The Characteristic Equation
  - 3.3.2-Causality and physical Realizability
- 3.4-The Sampled Signal Flow Graph
- 3.5-The modified z-Transfer Function
- 3.6-Multirate Discrete-Data Systems

4- DESIGN OF DIGITAL CONTROL SYSTEMS VIA TRANSFORM METHODS
- 4.1-Z-Domain Stability
- 4.2-Extended Z-Domain Stability Analysis: Jury's Test
- 4.3-Steady State Error Analysis
- 4.4-Routh-Locus Analysis
- 4.5-Bilinear Transformation
  - 4.5.1-S- and w-Plane Relationship
  - 4.5.2-Routh Stability Criterion in w-plane
- 4.6-s- z- and w-plane Time Response Characteristics Correlation
- 4.7-Frequency Response
- 4.8-Cascade Compensation by Continuous-Data Controllers
- 4.9-Design of Continuous-Data Controllers with Equivalent Digital Controllers

5- ROOT LOCUS

Fifth (5th) Year
Semesters 09/10

CONTROL Option

EE521 Programmable Logic Controllers

Textbook: Programmable Logic Controllers.

Lec/Lab./Rec./Credit Hours: (1h30, 1h30, 1h30, 3)

Topics

1- Introduction to PLCs
   - Microprocessors evolution
   - Micro-controllers
   - Application Specific ICs (ASICs)
   - Application of PLCs

2- PLC Architecture
   - Example Architectures
   - Logic Circuitry
   - I/O Ports
   - RAM/EPROM
   - Power Interface

3- Introduction to Programming
   - Instruction Set
   - Ladder Diagram
   - Programming Examples

4- Advanced PLC Functions
   - Ladder Diagram Simplification
   - Advanced Functions (Timing, Delay)
   - Power Interfacing

5- Advanced PLC Programming
   - Problem specification
   - Problem solving

Course title: *EE543 Advanced IC's*
Lec./Rec./Lab.: *3/0/3 Hours per week*
Class: *E09*

Course Outline

1- ADVANCED IC'S INTERFACING THE PC RESOURCES

1.1 The PC resources (processor, memory, I/O, storage)
1.2 System related data (ROM BIOS) and system services (Bios and DOS).

2- DEVELOPMENT TOOLS

2.1 Assembly language
2.2 Turbo C
2.3 System programming using the three levels (registers, BIOS, HLL)
2.4 Debugging techniques and tools

3- THE VGA GRAPHICS CARD

3.1 Architecture and Interfacing of the VGA card
3.2 Graphical concepts (Video RAM, special and color resolution, palette, etc...)
3.3 The VGA graphics card (CRTC MC6845, VGA Processor, Color Registers, Attribute registers, etc...)
3.4 Text mode (attribute & fonts), Graphic mode (Bitplanes, etc...)
3.5 Programming examples in three levels (register, BIOS and C)

4- APPLICATIONS OF THE VGA CARD

4.1 Reading and displaying formatted images using the graphics C library
4.2 Drawing 3D shapes using the graphics library.

5- THE RS232 COMMUNICATION CARD

5.1 Architecture and Interfacing
5.2 Communication concepts (Protocol of communication, Synchronization, etc...)
5.3 The RS232 card (Intel 8251A USART, bus transceivers, DB9 and DB25 connectors)
5.4 Seven-Wire Null modem
5.5 Programming examples in three levels (register, BIOS and C)

6- APPLICATIONS

6.1 Testing faulty ports
6.2 Communication between PC's
6.3 Using the MSDOS interlink & server
6.4 Synchronous communication.

Course title: *EE554 Digital Control Systems II*
Lec./Rec./Lab.: *3/0/0 Hours per week*
Class: *E09.*

Course Outline

1- DESIGN OF DIGITAL CONTROL SYSTEM VIA TRANSFORM METHODS

- 1.1-Digital Controllers
  - 1.1.1-Physical Realizability Considerations
  - 1.1.2-Realization of Digital Controllers by Digital Programming
  - 1.1.3-The Digital PID Controller
- 1.2-Design of Digital Control Systems With Digital Controllers Through Bilinear Transformation
  - 1.2.1-A Phase-Lead Controller
  - 1.2.2-A Phase-Lag Controller
- 1.3-Design in the Z-plane Using Root-Locus Diagram
  - 1.3.1-Phase-Lead and Phase-Lag Controllers
  - 1.3.2-The digital PID Controller
  - 1.3.3- The digital PD Controller
  - 1.3.4- The digital PI Controller
- 1.4-Two-Degree of Freedom Compensation
- 1.5-Desing of Robust Control Systems
- 1.6-Design of Discrete-time Systems with Deadbeat Response

2-THE STATE -SPACE ANALYSIS

- 2.1-State Equations of Discrete-Data Systems with Sample and Hold Devices
- 2.2-State Equation of Digital Systems with All Digital Elements
- 2.3-The State Transition Equations
- 2.4-Relationship Between State Equations and Transfer Functions
- 2.5-Methods of Computing the State Transition Matrix
- 2.6-Decomposition of Discrete-Data Transfer Functions
  - 2.6.1-Direct Decomposition
  - 2.6.2-Cascade Decomposition
  - 2.6.3-Parallel Decomposition
- 2.7-State Diagrams of Discrete-Data Systems
- 2.8-State-Variable Analysis of Response Between Sampling instants

3-CONTROLLABILITY AND OBSIRVABILITY

- 3.1-Controllability
- 3.2-Obsirvability
- 3.3-Relationships Between Controllability, Observability, and Transfer Functions
- 3.4-Controllability and Obsirvability Virus Sampling Period
- 3.5-Design of Digital Observers

4-DESIGN OF DIGITAL CONTROL SYSTEMS IN STATE-SPACE

- 4.1-Pole-Placement Design By State Feedback (Single Input)
- 4.2-Pole-Placement Design By State Feedback (Multi Inputs)
- 4.3-Design of Digital Control Systems with State Feedback and Dynamic Output Feedback
- 4.4-Realiztion of State Feedback by Dynamic Controllers

Course title: *EE555 Optimal Control*
Lec./Rec./Lab.: *3/0/0 Hours per week*
Class: *E09.*

Course Outline

1- REVIEW

1.1 Some important mathematical preliminaries (Special matrices, partitioned matrices, Eigenvectors, similarity transformations, etc...)
1.2 Mathematical description of dynamic systems (State space representations, canonical forms to the controller and observer forms, controllability, observability, etc...)

2- UNCONSTRAINED DESIGN

2.1 The unconstrained pole placement design problem.
2.2 State space design via controller form transformation.
2.3 Observation design: open and closed-loop observer design.

3- OPTIMIZATION THEORY

3.1 Unconstrained nonlinear programming.
3.2 Constrained nonlinear programming.
3.3 Convergence issues in nonlinear programming algorithms.

4- OPTIMAL CONTROL

4.1 Problem formulation.
4.2 Representation of dynamic processes.
4.3 Constraints.
4.4 Performance measure.

5- DYNAMIC PROGRAMMING BELLMAN'S OPTIMALITY PRINCIPLE.

5.1 Conversion of the problem to a multistage decision problem.
5.2 Solution of the general problem.
5.3 Application to the discrete-time linear optimal regulator and the discrete-time Ricatti equation.
5.4 The HJB equation
5.5 Application to the continuous-time linear optimal regulator and the continuous-time Ricatti equation.

6- VARIATIONAL APPROACH

6.1 Elements of the calculus of variations.
6.2 Derivation of the optimality condition.
6.3 Boundary conditions.
6.4 Specified end points problems, free final time-specified final state problems, specified final time-free final state problems, free final end problems.
6.5 Application to the continuous-time linear optimal regulator.
6.6 The general Ricatti equation and the algebraic Ricatti equation.
6.7 Numerical issues on the solution of the Ricatti equation.

Course Title : EE556 SystemsIdentification
Lec. / Rec. / Lab. : 03 / 00 / 00 Hours per week
Class:E10

Course Outline

Chapter 1: Introduction to system identification

1.1: Review of the various representations, and properties of Time-invariant linear systems.

1.2: Generalities on system identification: How to build models, and how to verify a model.

Chapter 2: Least square theory

2.1: The linear model

2.2: Identification of the parameters of a linear model

2.3: Statistical Properties of the estimated parameters

2.4: Interpretation of the Confidence intervals, and the variances of the estimators

2.5: Importance of the whitness of the noise, and the choice of the explanatory variables.

2.6: The recursive Least square algorithm

Chapter 3: Nonparametric identification of the impulse response of a SISO LTI system

3.1: Case of non-noisy measurements

3.2: Case of noisy output measurmenents
- Least square method
- Correlation method

3.3: Identification of rational transfer functions

Chapter 4: Nonparametric identification of the frequency response of a SISO LTI system

4.1: Review of Fourier analysis

4.2: Estimation of signal spectra

4.3: Statistical Properties of the spectrum

4.4: Identification of the frequency response & transfer function using spectral analysis.

Chapter 5: Parametric methods of identification

5.1: Review of the various parametric family of models: Linear , Ready made models

5.2: Various criterion of optimisation

5.3: Identification of the parameters of the models AR(p), , ARMA(p,q), and ARMAX(p,q)

5.4: Model properties and simulation

Chapter 6: Model validation and Model use

6.1: Model Validation

6.2: Domain of Validity of the Model

6.3: Residual analysis

6.4: Use of several models

EE532

Course title : . *Quality Control*
Lec./Rec./Lab. :*3/0/0 Hours per week*
Class: *E10*

Course Outline

1-NATURE AND SCOPE
- 1.1-Introduction
- 1.2-Definitions
- 1.3-Quality control functions
- 1.4-Relationship to Reliability

2-ORGANIZATION
- 2.1-Purpose of Organising
- 2.2-Location within the Total Enterprise
- 2.3-Internal Organisation of the Quality Control

3-PERSONNEL
- 3.1-Introduction
- 3.2-Labor
- 3.3-Engineering and Scientific personnel
- 3.4- Supervisory and Management Personnel

4-TRAINING
- 4.1Training for Labor Positions
- 4.2-Training for Engineering and Scientific Employees
- 4.3-Training for Supervisory and Management Personnel

5-QUALITY SYSTEMS AND PROCEDURES
- 5.1-Requirements for Systems and Procedures
- 5.2-Systems and Procedures Defined
- 5.3- Systems and Procedures Analysis
- 5.4-The Quality Control Manual

5-QUALITY COSTS
- 6.1-Introduction
- 6.2-Classes Of the Firm's Costs
- 6.3-Quality Costs and Losses
- 6.4-Implementation
- 6.5-Accounting for Quality Costs and Losses

7-QUALITY MOTIVATION
- 7.1-Introduction
- 7.2-Elements of Motivation Program
- 7.3-Motivation and Quality Control

8-QUALITY AUDIT

- 8.1-Systems and Procedures Conformance Audit
- 8.2-Systems and Procedures Effectiveness Audit
- 8.3-Product Audit
- 8.4-Organizing for Audit
- 8.5-Conducting the Audit
- 8.6-Reporting Audit Results

9-CONTROL OF ENGINEERING QUALITY

- 9.1-Engineering's Role in Quality Creation
- 9.2-Establishing Quality Objectives
- 9.3-Selection of Quality Characteristics
- 9.4-Spesification of Quality
- 9.5- Evaluation of Engineering Quality

10-CONTROL OF PURCHASED MATERIAL QUALITY

- 10.1-Purchasing's Role in Quality Creation
- 10.2-Make or Buy Committees
- 10.3-Source Selection
- 10.4-Source Inspection
- 10.5- Receiving Inspection
- 10.6-Corrective Action
- 10.7-Surveillance of Warehouse and Storage Facilities

11-CONTROL OF MANUFACTURING QUALITY

- 11.1-Manufacturing's Role in Quality Creation
- 11.2-Evaluation of the production process
- 11.3-Measurement and Measuring Equipment
- 11.4-Process Control
- 11.5-Inspection
- 11.6-Acceptance Sampling
- 11.7-Quality Information
- 11.8-Packaging

12-ACTION SUPPORTING THE PRODUCT AFTER DELIVERY

- 12.1-Product Support
- 12.2-Control of Service Publications
- 12.3-Control of spare parts
- 12.4-Modification and Repair
- 12.5-Field results