Fourth (4th) Year
Semesters 07/08

POWER ELECTRONICS/DRIVES Option

Course title: *EE322 Digital Systems II*
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

431

EE331 Electric Machines II
Credit/Lec/Rec/Lab : (4, 3, 0, 3).
Promotion : E07/Power Electronics/Drives

Part one: Basic Concepts

1- Main types of AC machines
2- E.M.F. in AC machines windings
3- Three-phase and single-phase windings of AC machines
4- E.MF. in AC machines windings
5- Revolving fields

Part two: Synchronous Machines

1- Main elements of synchronous machines
2- Operation as three-phase alternator
3- Single-phase alternators
4- Operation as three-phase motor
5- Single-phase synchronous motor

Part three: Asynchronous Machines

1- Different types and Construction
2- Operation as three-phase motor
3- Operation as three-phase asynchronous generators
4- Operation as single-phase motor

Laboratory experiments

1- Alternator: Behn-Eshenburg and Potier diagram, Load studies (isolated), Connection to network.
2- Synchronous motor: Mordey curves, Blondel diagram.
3- Asynchronous motor Circle diagram, Identification of the equivalent circuit, Load studies.
4- Operation as asynchronous generator.
5- ' Arbre électrique' Electric

Course title: ***EE332 Power Electronics I***
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

6-DC-DC CONVERTERS

6.1-Commutation in DC systems and the circuits used to turn off SCR's
6.2-Principles of basic DC chopper circuits with particular reference to waveforms

7-INVERTERS

7.1-Principles of single phase inverters, including series and parallel configurations
7.2-Filters and other techniques used to improve output waveforms

8-FREQUENCY CHANGING

*Principles of cycloconverters and cycloinverters

9-POWER FACTOR CHANGES

*Principles of basic networks for power factor correction

10-POWER CONTROL SYSTEMS

*The principles that have been discussed in the previous sections will now be applied to industrial and commercial systems Areas to include:

10.1-Motor speed control systems
10.2-Lighting systems
10.3-Heater controls

11-PROTECTION SYSTEMS

11.1-Generation and elimination of transients
11.2-Cooling and Heat Sinks
11.3-Selection of fuses to protect devices

LABORATORY EXPERIMENTS

1- a- Use of curve tracer and oscilloscope to display the major characteristics of the SCR; TRIAC
b-Laboratory demonstration of reverse-recovery current

2- a-Display and record all circuit waveforms in single phase rectifier operating in half-wave mode
with R, R & L, back emf and freewheeling diode loads
b-Observe switching transients
c-Measure output parameters
d-Laboratory demonstration of frequency-spectrum
e-Repeat (a) with fullwave center-tapped and bridge networks

3-Repeat (2) for 30 halfwave and fullwave bridge

4-Investigate basic phase-shift networks using C-R and C-R and DIAC networks

5-Repeat (2) with rectifiers replaced with combinations of rectifier and SCR's

6- a-Investigate 1-phase AC phase control using TRIACs and inverse parallel SCR's
b-Note RFI on input waveform
c-Introduce RFI suppression filters
d-Display and record all circuit waveforms and compare circuit performance with available performance data for Po;Vo; harmonics

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: *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

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

EE 431/432 ELECTRONIQUE DE PUISSANCE
(option: Commande et Machines Electriques)

VOLUME HORAIRE HEBDOMADAIRE :

COURS	TD	TP
3h	1h30	1h30

I: ELEMENTS SEMI-CONDUCTEURS EN ELECTRONIQUE DE PUISSANCE

I-1: Introduction
I-2: Les diodes (diode de Redressement, diode Rapide, diode Shotcky)
I-3: Les Thyristors (SCR, TRIAC, GTO)
I-4: Les Transistors (BJT, MosFet, IGBT)
Les Calcs.
I-5: Protection des éléments semi-conducteurs

II: CONVERTISSEURS COURANT ALTERNATIF - COURANT CONTINU

II-1: Redressement non commandé (avec différentes charges: R.L.E)
Montages Redresseurs
- monophasé
- polyphasé
- triphasé

Paramètres de Performances (FP, FD ...etc)
II-2: Redressement commandé à Thyristor.
Montages Redresseurs Monophasé
- Complètement commandé
- Semi-commandé

Montages Redresseurs Triphasé.
- En demi pont.
- En pont

Fonctionnement réel d'un redresseur Commandé (Phénomène d'empiétement, Ratée d'amorçage, Réaction d'un redresseur sur le réseau)

III: CONVERTISSEURS COURANT CONTINU- COURANT CONTINU.

III-1: Principe de la conversion CC CC
III-2: La Commutation Forcée (Principe, Circuits ...etc..)
III-3: Les Hacheurs
- hacheur série.
- hacheur parallèle.
- hacheur réversible

IV: CONVERTISSEURS COURANT CONTINU- COURANT ALTERNATIF.

IV-1: Principe de la conversion CC CA.
IV-2: Onduleurs de Tension Monophasés et Triphasés (avec charge R et RL)
IV-3: Paramètres de Performances et étude Harmoniques
IV-4: Techniques MLI.
IV-5: Onduleurs de Courant (ASCI)
IV-6: Onduleurs à Résonance

V: CONVERTISSEURS COURANT ALTERNATIF COURANT ALTERNATIF.

V-1: Les Gradateurs
- Principe de la conversion CA CA. (Fréquence Fixe)
- Gradateur Monophasé (Charge R et RL).
- Gradateur Triphasé (Charge R).

V-2: Les Cycloconvertisseurs
- Principe de la conversion CA CA. (Fréquence Variable).
- Cycloconvertisseur avec et sans Courant de Circulation.
- Cycloconvertisseur à Enveloppe.

VI: Notions de dualité dans les convertisseurs statiques

VII: CIRCUITS DE COMMANDE

VII-1: Circuit de commande d'un pont Redresseur (Synchronisation, Génération d'impulsions, Amplification, Isolation galvanique ...etc...)
VII-2: Circuit de commande d'un Onduleur (Avec tension rectangulaire, MLI...etc...)

VIII: APPLICATIONS

VIII-1: Alimentations à découpage.
VIII-2: Alimentations à étages intermédiaire HF.
VIII-3: Compensateur statique d'énergie réactive.

TP Electronique de Puissance
4ème année (Commande, Réseaux, Machines)

- Redressement non commandé monophasé et triphasé (charges R,L,E)
- Redressement commandé monophasé et triphasé (charges R,L,E)
- Composant en commutation (BGT, MOS)
- Hacheur à thyristors
- Onduleur monophasé
    * à résonance
    * à source de courant
- Gradateur monophasé (charges R, L)

EE433 COMMANDE ELECTRIQUE I
(Option: Commande)

VOLUME HORAIRE HEBDOMADAIRE :

VHH COURS	VHH TD	VHH TP
3h	1h30	1h30

I: GENERALITES
- Rappel sur les caractéristiques mécaniques des machines à CC
- Rappel sur les procédés de démarage et de freinage des moteurs à CC
- Caractéristiques des systèmes de commande (Stabilité, Rigidité, Progressivité et gamme de réglage, rendement ...etc.)

II CARACTéRISTIQUES DE RéGLAGE
- Rhéostatique
- par variation de la Tension d'alimentation
- par variation du Flux d'éxcitation.

III: ASSOCIATION MCC/REDRESSEUR COMMANDé
- Fonctionnement en 2 Quadrants
  * Conduction continue et discontinue
- Fonctionnement en 4 Quadrants
  * sans courant de circulation
  * avec courant de circulation
- Reglage de vitesse d'un moteur à CC en boucle fermée

IV: ASSOCIATION MCC/HACHEUR
- Moteur à excitation séparée
  * Entrainement
  * Freinage par recupération
- Moteur à excitation série
  * Entrainement et traction electrique
- Reglage de vitesse d'un moteur à CC en boucle fermée

V: CHOIX DE LA PUISSANCE D' UN MOTEUR A COURANT CONTINU

TP Commande Electrique I
4ème année (Commande)

- Caractéristiques de reglage de vitesse des Moteurs à courant continu (excitation séparée et série) et étude comparative.

- association redresseur à thyristors / Machine à courant continu
  * caractéristique de reglage en boucle ouverte et en boucle fermée

- association hacheur / Machine à courant continu
  * caractéristique de reglage en boucle ouverte et en boucle fermée

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

POWER ELECTRONICS/DRIVES Option

EE531 ELECTRONIQUE DE PUISSANCE AVANCEE
(Option : Commande Electrique)

VHH COURS	VHHTD	VHH TP
3h	1.5	0

I : NOUVELLES STRUCTURES DE CONVERTISSEURS
- Redresseur MLI
- Gradateur MLI
- Convertisseur Matricielle

II: AMELIORATION DU FACTEUR DE PUISSANCE

III: ELIMINATION DES HARMONIQUES
- Introduction (importance et représentation des normes)
- Stratégie de commande à MLI
- Techniques d'injection d'harmoniques
- Filtrage passif
- Filtrage Actif

IV: COMPENSATEUR STATIQUE DE PUISSANCE REACTIVE (SVC)

V: TRANSPORT D'ENERGIE EN COURANT CONTINU A HAUTE TENSION (HVDC)

EE532 COMMANDE ELECTRIQUES II
(Option : Commande Electrique)

VHH COURS	VHHTD	VHH TP
3h	1.5	1.5

Partie I : PROCEDES DE VARIATION DE VITESSE DE LA MACHINE A COURANT ALTERNATIF

- Variation de la tension d'alimentation
- Variation de fréquence
- Cascade hyposynchrone

Partie II : ASSOCIATION MACHINES A COURANT ALTERNATIF / CONVERTISSEUR DE FREQUENCE

- Commande scalaire
- Commande verctorielle
- Commande des machines synchrones autopilotées

TP Commande Electrique II
5ème année (Commande)

- Caractéristiques de reglage de vitesse des machines à courant alternatif
  * par reglage de la tension d'alimentation
  * par variation de la fréquence
  * cascade hyposynchrone

- association machine à courant alternatif / convertisseur de fréquence
  * caractéristique de reglage en boucle ouverte et fermée

- Machine Synchrone Autopilotée

MATERIAUX DE L'ELECTROTECHNIQUE

Volume horaire hebdomadaire: Cours : 1h30; TD : 1h30; TP : 1h30

Introduction:

Rôle et place des matériaux dans l'industrie électrotechnique.

I Matériaux Magnétiques

I.1 Le magnétisme du point de vue microscopique.
- Paramagnétisme.
- Diamagnétisme.

I.2 Le ferromagnétisme.
- Théorie de Weiss.
- Théorie de Neel.
- Champ démagnétisant.

I.3 Caractérisation des substances magnétiques.
- Matériaux magnétiques doux.
- Matériaux magnétiques durs.
- Comportement en continu.
- Comportement en alternatif (hystérésis, courants de Foucault, phénomènes démagnétisants).

I.4 Mesure des pertes magnétiques et des perméabilités magnétiques (essais normalisés).

I.5 Choix et dimensionnement des matériaux magnétiques pour les machines électriques.

I.6 Les aimants permanents.

II Matériaux Diélectriques.

II.1 Rappels sur le champ électrique en présence de matériaux diélectriques- l'induction électrique.

II.2 Les divers types de polarisation des diélectriques.

II.3 Comportement de diélectriques en champ alternatif.
- Pertes diélectriques.
- Mesure des pertes diélectriques.

II.4 Les différents mécanismes de conduction dans les diélectriques.

II.5 Claquage dans les diélectriques.
- Essais normalisés.

II.6 Isolants et isolation.
- Classes d'isolants.
- Dimensionnement de l'isolation.

II.7 Notions sur la ferroélectricité et la piezoélectricité

III Matériaux conducteurs.

III.1 Les électrons libres dans les conducteurs.

III.2 Profondeur de pénétration du champ électromagnétique.

IV Matériaux supraconducteurs.
- Notion de supraconductivité.
- Application de la supraconductivité

TP Matériaux d'électrotechnique

3ème année (Machines et commande électriques et réseaux)

1-Détermination de l'induction magnétique en courant continu : utilisation du fluxmètre

2-Cycle d'hystérésis

3-le spintermètre : claquage de l'huile isolante

4-Cadre Epstein

-Détermination de l'induction magnétique

-Détermination de la perméabilité magnétique

-Détermination de la puissance apparente et des pertes spécifiques

EE534 APPAREILLAGE ET SCHEMAS ELECTRIQUES
(Option: Machines/Commande/Réseaux)

VOLUME HORAIRE HEBDOMADAIRE :

COURS	TD	TP
3h	1h30	1h30

I: FONCTION DE L'APPAREILLAGE.
- Classification suivant la fonction .
- Classification suivant la tension.
- Choix de l'appareillage électrique.
- Caractéristiques des appareils.

II: PHENOMENES DE CONTACTS ELECTRIQUES
- Comportement d'un contact
- Différents types de contacts
- Caractéristiques d'un contact
- Contraintes thermiques et électrodynamiques

III: PHENOMENES LIES AUX COURANTS ET A LA TENSION.
- Les surintensités.
- Les efforts électrodynamiques
- Calcul de la résistance de l'arc
- Effets de l'arc sur le contact
- Les surtensions
- Isolation, claquage, rigidité
- Ionisation des gaz

IV PHENOMENES D'INTERRUPTION DU COURANT ELECTRIQUE.
- Naissance de l'arc(dans l'air et dans l'huile)
- Principe de coupure de l'arc (dans l'air et dans l'huile)
- Conditions d'extinction de l'arc
- Tension de rétablissement
- Différentes techniques de coupure de l'arc

V APPAREILLAGE DE CONNEXION.
- Les contacts ,Bornes et connexions ,prises de courant ,sectionneurs.

VI APPAREILLAGE D'INTERRUPTION.
- Les interrupteurs (définition ,rôle et Caractéristiques)
- Commutateurs (définition , rôle et caractéristiques)
- Contacteurs (définition , rôle et caractéristiques).

VII APPAREILLAGE DE PROTECTION.
- Coupe-circuits à fusibles(rôle et fonctionnement, types, équations).
- Relais de protection (définition, rôle, types et caractéristiques)
- Discontacteurs (définition , rôle et caractéristiques)
- Disjoncteurs(définition, rôle, types et caractéristiques)

VIII APPAREILLAGE DE REGLAGE.
- Rhéostat, potentiomètre, inductances, condensateurs.

IX ELABORATION DES SCHEMAS ELECTRIQUES.
- Conventions et normalisation
- Symboles des installations électriques
- Mode de représentation
- Câblage
- Exemples de lecture des schémas (de commande et de puissance)

TP Schémas et appareillages
4ème année (Réseaux-Machines et Commande))

I / Installation électrique.
- Montage simple allumage, double allumage, va-et-vient, cage d'escaliers, luminaire.
- Telerupteurs, muniteries, sonneries, gâches électriques, etc....

II / Commande des machines électriques:
- Commande d'un moteur à un et deux sens de rotation.
- Démarrage d'un moteur en étoile triangle, étoile résistance triangle.
- Commande des moteurs à deux vitesses.
- Démarrage statorique et rotorique.
- Démarrage des machines à courant continu
- Monte-charge, machines outils etc...

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

EE535 Sécurité industrielle

V.H.H COURS	V.H.H T.D	V.H.H T.P
1h30	0	0

Chapitre 1: Introduction
- Définition
- Les buts principaux de la sécurité de travail

Chapitre 2: Etats de la technique de sécurités
- Accidents et maladies
- Méthodes de l'analyse du traumatisme de protectioc
- Stastique
- Méthodes monagraphiques
- Méthodes économiques

Chapitre 3: Dangers présentés par les courants électriques
- Causes principales de l'électro-traumatisme
- Causes principales d'électrocution
- Action du courant électrique sur l'individu
- Classification des locaux de protection selon le degré de l'électrocution
  - Les locaux à danger élevé
  - les locaux à danger particulier
  - les locaux sans danger élevé

Chapitre 4: Les cas des contacts avesc le fil électrique

- Contact bipolaire avec le réseau monophasé
- Contact unipolaire avec le réseau monophasé
- Contact bipolaire avec le réseau triphasé
- Contact monopolaire avec le réseau triphasé à neutre isolé
- Contact monopolaire avec le réseau triphasé à neutre mise à la terre

Chapitre 5: La mise à la terre de la protection
- Les installations électriques qui doivent êtres mises à la terre
- Les normes de la résistance de mise à la terre
- Installation de la mise à la terre.
- Mise à la terre de contour
- Mise à la terre éloigné
- Mise à la terre individuelle

Chapitre 6: Les bruits et vibrations

- L'action du bruit et des vibrations sur l'organisme humain
- Définition essentielle du bruit et vibration
- Les normes du niveau de bruit admissible
- Les luttes contre les bruits et les vibrations.

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

EE592 ECONOMIE

VHH COURS	VHH TD	VHH TP
1.5h	0	0

A. Notions de comptabilité:

I. Les principes comptables
II. Analyses des états financiers
III. Les équilibres financiers
IV. Diagnostic financier

B. Gestion d'Entreprise:

I. Principes fondamentaux de gestion:

II. Comptabilité générale (Analyse financière des comptes de résultats, capacité d'autofinancement, Principes généraux de fiscalité,

III. Contrôle de gestion: (Esprit du contrôle de gestion, incidence du facteur humain mode de direction)

IV. Comptabilité analytique (objectifs, calcul et suivi des coûts de revient, les différents choix analytiques, les analyses économiques, seuil de rentabilité, apport de la comptabilité analytique dans la prise de décisions)

V. La trésorerie: (les différentes étapes des prévisions de trésorerie à court terme, la gestion de la trésorerie au jour le jour).

C. Aspects juridiques et économiques du métier de l'Ingénieur:

I. Droit du travail (législation de travail, contrat de travail, rupture, licenciement, indemnisation, recours devant les tribunaux administratifs)

II. Droit commercial et contrats (le droit commercial, le contrat commercial, les techniques de négociation contractuelle, les modes de financement des entreprises, les litiges commerciaux, les faillites).