Third (3rd) Year

Semester 06

Course title: *EE102 Electrical engineering II*
Lec./Rec./Lab.: *3/0/3 Hours per week*
Class: *E02*

Course Outline

1-CAPACITANCE, INDUCTANCE

- 1.1-Introduction
- 1.2-The inductor
- 1.3-Integral relationships for the Inductor
- 1.4-The Capacitor
- 1.5-Inductance and Capacitance Combinations
- 1.6-Duality

2-SOURCE-FREE RL AND RC CIRCUITS, NATURAL RESPONSE

- 2.1-The simple RL Circuit
- 2.2-Properties of the Exponential Response
- 2.3-A more general RL circuit
- 2.4-The simple RC circuit
- 2.5-A more general RC circuit

3-DRIVEN RL AND RC CIRCUITS, FORCED RESPONSE

- 3.1-The Unit-Step forcing function
- 3.2-A first look at the driven RL circuit
- 3.3-The natural and the forced response

4-THE RLC CIRCUIT

- 4.1-The source-free parallel circuit
- 4.2-The overdamped parallel RLC circuit
- 4.3-Critical damping
- 4.4-The underdamped parallel RLC circuit
- 4.5-The source-free series RLC circuit
- 4.6-The complete response of the RLC circuit

5-THE SINUSOIDAL FORCING FUNCTION

- 5.1-Characteristics of sinusoids
- 5.2-Forced response to sinusoidal forcing functions

6-THE PHASOR CONCEPT

- 6.1-The complex forcing function
- 6.2-The phasor
- 6.3-Phasor relationships for R, L and C
- 6.4- Impedance
- 6.5-Admittance

7-SINUSOIDAL STEADY-STATE RESPONSE

7.1-Nodal, Mesh, and Loop Analysis

7.2-Superposition, Source transformations, and Thévenin's theorem

7.3-Phasor diagrams

8-RESPONSE AS FUNCTION OF ω

9-AVERAGE POWER AND RMS VALUES

9.1-Instantaneous power

9.2-Average power

9.3-Effective values of current and voltage

9.4-Apparent power and power factor

9.5-Complex power

LAB. EXPERIMENTS

1- Oscilloscope Orientation

2-Transients

3-RLC Transients

4-Reactances

5-Frequency Response

6-Series and parallel Circuits

7-Resonance

8-Transformers

9-Thévenin's Equivalent Circuits

Course title : *EE242 Active Devices and Circuits II (Electronics 2)*
Lec./Rec./Lab. : *03/01/03 hours per a week*
Class: *E04*

Course Outline

1-MULTIPLE-TRANSISTOR CIRCUITS
1.1-The difference Amplifier
1.2-Common-Mode Rejection Ratio
1.3-Difference Amplifier with Constant Current Source
1.4-Difference Amplifier with Emitter Resistors for Balance
1.5-Difference Amplifier using FETs
1.6-The Darlington Amplifier
1.7-The Cascode Amplifier
1.8-The Operational Amplifier
1.9-Examples of a Complete Op-Amp

2-APPLICATIONS OF OPERATIONAL AMPLIFIERS
2.1-The linear Inverting Amplifier
2.2-Linear Noninverting Amplifier
2.3-Feedback
2.4-Linear operations using the Op-Amp
2.5-Nonlinear Op-Amp Applications
2.6-Bootstrap Sweep Generator
2.7-Logarithmic Amplifier
2.8-Feedback-Regulated Power Supplies
2.9-Four-Quadrant Analog Multiplier
2.10-Automatic Gain Control
2.11-Practical Consideration in Op-Amp Circuits
2.12-Other Linear IC Amplifiers

3-FREQUENCY AND SWITCHING-SPEED LIMITATIONS
3.1-The Low-Frequency Response of the Transistor Amplifier
3.2-The Low-Frequency Response of the FET Amplifier
3.3-The Transistor Amplifier at High Frequencies
3.4-The FET at high Frequencies
3.5-Tuned Amplifiers
3.6-The Gain-Bandwidth Product
3.7-The Transistor Switch

4-FEEDBACK,FREQUENCY COMPENSATION OF OP-AMPS, AND OSCILLATORS
4.1-Basic concept of Feedback
4.2-Frequency Response of a Feedback Amplifier
4.3-The problem of Stability: A Three Pole Amplifier
4.4-Bode Plots
4.5-Stabilizing Networks
4.6-Frequency Compensation of Op-Amps
4.7-Sinusoidal Oscillators

LAB. EXPERIMENTS

1-Treggering an Oscilloscope
2-Basic Operational Amplifier Circuits
3-Operational Amplifier Applications
4-Active Filters
5-Darlington Pair
6-Feedback
7-The Difference Amplifier
8-Complementary Symmetry
9-Oscillators

Course Title : EE301 Linear systems I: continuous-time signals and systems
Lec. / Rec. / Lab. : 03 / 01 / 00 Hours per week
Class:E06

Course Outline

Chapter 1: Signals and systems
- **1.1:** Definition of continuous & discrete time signals
- **1.2:** Transformations of the independent variable (time): related signals
- **1.3:** Basic continuous -time signals
- **1.4:** Definition and properties of systems

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

Chapter 3: Fourier Analysis for continuous-time signals and systems
- **3.1:** Response of continuous-time LTI systems to complex exponentials
- **3.2:** Fourier series representation of continuous time periodic signals
- **3.3:** Approximation of periodic signals using Fourier series and their convergence
- **3.4:** Continuous -time Fourier transform of aperiodic signals
- **3.5:** Continuous-time Fourier transform of periodic signals
- **3.6:** Properties of the continuous -time Fourier Transform and the inverse Fourier Transform
- **3.7:** Polar representation of continuous-time Fourier transform
- **3.8:** The frequency response of systems characterised by linear constant-coefficient differential equations
- **3.9:** Bode plot of LTI systems
- **3.10:** Determination of the Transfer function, the impulse response, and steady state response from the frequency response

Chapter 4: The Laplace Transform
- **4.1:** The Laplace transform: Generalisation of the continuous -time Fourier Transform
- **4.2:** The region of convergence for Laplace Transform
- **4.3:** The inverse Laplace Transform
- **4.4:** Geometric evaluation of the Fourier Transform from the Pole-Zero plot
- **4.5:** Properties of the Laplace Transform
- **4.6:** Analysis and characterisation of LTI systems using Laplace Transform
- **4.7:** The unilateral Laplace Transform
- **4.8:** Determination of the complete response of LTI system using Laplace Transform

Course title: ***EE321 Digital Systems I***
Lec./Rec./Lab.: ***3/0/3 Hours per a week***
Class: ***E05***

Course Outline

1- INTRODUCTION
- 1.1- What is digital electronics?
- 1.2- Historical background of digital systems
- 1.3- Examples of digital systems

2- NUMBER SYSTEMS
- 2.1- Definition of base or radix
- 2.2- Number systems representation
- 2.3- Decimal-to-binary conversion
- 2.4- Decimal-to-base r conversion
- 2.5- Octal/hexadecimal number systems
- 2.6- Octal-hexadecimal-octal conversion
- 2.7- Complements.
- 2.8- Subtraction of binary numbers

3- BOOLEAN ALGEBRA
- 3.1- Symbols used in Boolean algebra
- 3.2- Basic logic operations (- AND, - OR, - NOT)
- 3.3- Boolean postulates
- 3.4- Boolean theorem
- 3.5- De Morgan's theorem
- 3.6- NAND and NOR operations
- 3.7- Minimization using Boolean algebra
- 3.8- Standard forms
- 3.9- Conversion from SOP to SSOP
- 3.10- Conversion from POS to SPOS
- 3.11- Numerical representation of SSOP and SPOS
- 3.12- Relationship between SSOP and SPOS.

4- KARNAUGH MAP TECHNIQUE
- 4.1- Definition of Karnaugh map.
- 4.2- Construction of KMs
- 4.3- Application of KM to minimize Boolean expressions
- 4.4- Definition of : Implicant, Prime implicant, Essential prime implicant
- 4.5- Karnaugh maps with variables in cells
- 4.6- Don't care conditions
- 4.7- Quine Mc-Clusky method
- 4.8- NAND-NAND networks
- 4.9- NOR-NOR networks
- 4.10- Implementation of AND-OR using NAND gates
- 4.11- Implementation of OR-AND using NOR gates

5- INTEGRATED CIRCUIT LOGIC FAMILIES
- 5.1- Evolution of logic families
- 5.2- Digital IC technologies

5.3- Current and Voltage parameters
5.4- Diode gates
5.5- Resistor transistor logic RTL
5.6- Diode transistor logic DTL
5.7- Transistor-transistor logic TTL (74., 74L, 74S, 74AS, 74ALS)
5.8- Emitter coupled logic ECL
5.9- MOS technology: N-MOS gates, C-MOS gates
5.10- Comparison of TTL and CMOS characteristics
5.11- Interfacing: -TTL driving CMOS, - CMOS driving TTL

6- COMBINATIONAL CIRCUITS
6.1- Definition
6.2- Design of combinational circuits: Truth table, Minimization, Implementation
6.3- Arithmetic and logic circuits: XOR and XNOR operations
6.3.1-Digital comparator: Design od 1-bit comparator, Design of an n-bit comparator, The MSI 7485 4-bit comparator, Cascading 7485's
6.3.2-Digital Adders: The Half adder, the Full adder, Design of an n-bit adder, The Look Ahead Carry LAC, The MSI 7483 4-bit Binary adder.
6.4- Application of binary adders: Binary-to-BCD converter, BCD adder
6.5- Implementation of binary subtractors using: - 1's complement, - 2's complement
6.6- BCD subtractors: - The 9's complement generators, - The 10's complement generator
6.7- Switching multiplier

7- SEQUENTIAL CIRCUITS, FLIP FLOPS
7.1- Definition of a sequential circuit
7.2- Definition of synchronous and asynchronous systems
7.3- Basic Reset-Set flip-flop (RS-FF) Using: - NOR gates, - NAND gates

LAB. EXPERIMENTS

1- Familiarization (3-hours)
2- Implementation of combinational circuits using (6-hour)
- AND, OR, NOT gates,
- NAND gates only,
- NOR gates only
3- Discrete logic gates (3-hours)
4- Arithmetic and logic circuits (9-hour)

Course title: *EE 331 Machinery I*
Lec./Rec./Lab. : *3/0/3 Hours per week*
Class: *E06*

Course Outline

1-MAGNITIC CIRCUITS
1.1-Magnitic Concepts
1.2-Magnitic Circuits
1.3-Leakage Flux
1.4-The Magnetization Curve

2-TRANSFORMERS
2.1-Types of Transformer
2.2-Elements of Transformer
2.3-Farada's Law and Lenz' Law
2.4-Magnetic Fluxes of a Transformer
2.5-Details of Transformer
2.6-The Ideal Transformer
2.7-A circuit Model of the Iron-core Transformer
2.8-The Approximate Transformer Circuit Models
2.9-Relative Magnitudes of the Circuit-Model Constants: The Per-Unit System.
2.10-Transformer Voltage Regulation
2.11-Transforming Three-Phase
2.12-Compuling Transformer Efficiency

3-SYNCHRONOUS MACHINES
3.1-Synchronous Machine Characteristics
2.2-Construction of a Synchronous Machine
2.3-Cylindrical-Rotor theory Versus Salient-Pole Theory
2.4-The Magnetomotive-Force MMF Field of the Rotor
2.5-The Rotating MMF of the Stator Armature Winding
2.6-The Circuit Model of the Synchronous Machine
2.7-Relative Magnitudes of Synchronous Machine Impedances: The Per-Unit System
2.8-Power and torque as related to Power Angle
2.9-Operation as Motor
2.10-Operation as Synchronous Condenser
2.11-The Synchronous Machine as Generator
2.12-The Short-Circuit Ratio
2.13-The Capability Curve
2.14-Short-Circuit Current Transients in Synchronous Alternators

4-INDUCTION OR "ASYNCHRONOUS" MACHINES
4.1-Construction of Induction Machines
4.2-How the Induction Machines Works
4.3-The Concept of Slip
4.4-The Frequency of Rotor Voltages and Current
4.5-The Induction Motor under Load

4.6-Circuit Model of the Induction Machine
4.7-Losses, Power Flow, and Efficiency of Induction Motors
4.8-Air Gap: The Magic Quantity
4.9-Separation of Mechanical Load from Rotor Copper Loss in the Circuit Model
4.10-Performance Calculations Using the Circuit Model
4.11-Torque-Speed Characteristics
4.12-Tests to Determine Circuit Model-Impedances
4.13-Starting Induction Motors
4.14-Speed Control of Induction Motors

5-DIRECT CURRENT DC MACHINES

5.1-The Importance of DC Machines
5.2-Constructin of DC Machines
5.3-How DC Machines Work
5.4-The Generated Voltage of DC Machines
5.5-Circuit Model of a DC Machine
5.6-Developed Torque
5.7-Field Excitation, Wound-Pole Machines
5.8-Speed Control Of Shunt and Permanent-Magnet (PM) Motors
5.9-DC Motor Starting and Braking
5.10-Armature Reaction and Commutation
5.11-Characteristis Of Series and Compound DC Motors
5.12-Self-Excited DC Generators
5.13-Armature Winding For Commutator Machines

LAB. EXPERIMENTS

1-The Wattmeter
2-Phase Angle, Real and Apparent Power
3-Capacitive Reactance
4-Reactive Reactance
5-Watt, Var Volt-Ampere and Power Factor
6-Vectors and Phasors
7-The single Phase Transformer
8-Three-Phase Transformer Connections
9-The DC Motor
10-The Synchronous Motor
11-The Three-Phase Alternator

Course title : *EE361 Electromagnetic Field Theory I*
Lec./Rec./Lab.: *03/01/00 Hours per week*
Class: *E06*

<u>Course outline</u>

1- INTRODUCTION

2-VECTORS AND FIELDS
- 2.1- Vector Algebra
- 2.2-Cartesian Coordinate System
- 2.3- Scalar and Vector Fields
- 2.4-Sinusoidally Time-Varying Fields
- 2.5- The Electric Field
- 2.6-The Magnetic Field

3-MAXWELL'S EQUATIONS IN INTEGRAL FORM
- 3.1- The Line Integral
- 3.2-The Surface Integral
- 3.3 Faraday's Law
- 3.4- Ampere's Circuital Law
- 3.5- Gauss's Law for the Magnetic Field
- 3.6-Gauss's Law for the Electric Field

4-MAXWELL'S EQUATIONS IN DIFFERENTIAL FORM
- 4.1-Faraday's Law
- 4.2-Amper's circuital Law
- 4.3-Curl and Stokes' Theorem
- 4.5-Gauss' Law for the electric field
- 4.6-Gauss' Law for the magnetic field
- 4.7-Divergence and the Divergence Theorem

5- WAVE PROPAGATION IN FREE SPACE
- 5.1- the Infinite Plane Current Sheet
- 5.2-Magnetic field Adjacent to the Current Sheet
- 5.3-Successive Solution Of Maxwell's Equations
- 5.4-Solution by Wave Equation
- 5.5-Uniform Plane Wave
- 5.6-Poynting Vector and Energy Storage

6-WAVE PROPAGATION IN MATERIAL MEDIA
- 6.1-Conductors
- 6.2-Dielectrics
- 6.3-Magnetic Materials
- 6.4-Wave Equation and Solution
- 6.5-Uniform Plane Waves in Dielectrics
- 6.6-Uniform plane Waves in Conductors