FUNDAMENTAL OF ELECTRICAL AND ELECTRONICS ENGINEERING

ENEX 101

Lecture : 3 **Year : I**
Tutorial : 1 **Part : I**
Practical : 3

Course Objectives:
Objective of the course is to understand the language of electronics, elements, and their functionality, to introduce the DC and AC circuit analysis and basic understanding of analog systems and their applications.

1 Basic Circuits Concepts (6 hours)

1.1 Current and potential
1.2 Passive components: Resistance, inductance, capacitance; Series, parallel combinations; Kirchhoff's voltage and current laws for DC circuits
1.3 Signal sources: Voltage and current sources; Non ideal sources; Representation under assumption of linearity; Controlled sources: VCVS, CCVS, VCCS, CCCS; Concept of gain, transconductance, transimpedance
1.4 Maximum power transfer, superposition theorem, Thevenin's theorem, Norton's theorem

2 Average and RMS Values (4 hours)

2.1 Generation of AC voltage
2.2 Waveform and its characteristics
2.3 RMS and average values of periodic waveforms

3 AC Circuit Analysis (12 hours)

3.1 Single-phase AC circuit analysis
- 3.1.1 Series, parallel and network circuits with sinusoidal excitations
- 3.1.2 The concept of complex impedance and admittance
- 3.1.3 Sinusoidal excitation of inductive and capacitive reactance and complex impedance
- 3.1.4 Concept of time phase differences between various sinusoidal quantities
- 3.1.5 Phasor concept and phasor representation of AC quantities
- 3.1.6 Transformed impedances and network reduction
- 3.1.7 Real, reactive and apparent power concepts

3.2 Three phase AC circuit
    3.2.1 Generation of three phase voltage
    3.2.2 Wye and delta connection

4 Diodes (7 hours)

4.1 Semiconductor diode characteristics
4.2 Modeling the semiconductor diode
4.3 Diode circuits: Clipper; Clamper circuits
4.4 Zener diode, LED, photodiode, Varactor diode, tunnel diodes
4.5 DC power supply: Rectifier-half wave, full wave (Center tapped, bridge), Zener regulated power supply

5 Transistor (10 hours)

5.1 BJT configuration and biasing, small and large signal model
5.2 T and π model
5.3 Concept of differential amplifier using BJT
5.4 BJT as switch and logic circuits
5.5 Construction and working principle of JFET, MOSFET and CMOS
5.6 MOSFET as logic circuits

6 Operational Amplifier and Oscillator (6 hours)

6.1 Basic model; Virtual ground concept; Inverting amplifier; Non-inverting amplifier; Integrator; Differentiator, summing amplifier and their applications
6.2 Basic feedback theory; Positive and negative feedback; Concept of stability; Oscillator
6.3 Waveform generator using op-amp for square wave, triangular wave, phase shift oscillator and Wien bridge oscillator for sinusoidal waveform

Practical (45 hours)

1. Familiarization with passive components, function generator and oscilloscope
2. Measurement of amplitude, frequency, time period using oscilloscope
3. Ohm's law, series, parallel circuits and calculate average, RMS value
4. Verification of KCL, KVL and network theorems
5. Maximum power transfer/ capacitor charging and discharging
6. Diode characteristics, rectifiers, Zener diodes
7. BJT characteristics and single stage amplifier
8. BJT, PMOS, NMOS and CMOS as switch
9. Inverting, non-inverting, summing and subtractor amplifier using Op-amp
10. Relaxation oscillator
11. Analog sensor and small projects

Reference

1. Boylestad, R. L., Nashelsky, L. (2008). Electronic devices and circuit theory (10th ed.). Pearson Education.

2. Floyd, T.L. (2011). Electronic devices (9th ed.). Pearson Education.
3. Sedra, A.S., Smith, K.C. (2014). Microelectronic circuits (7th ed.). Oxford University Press.
4. Cogdell, J.R. (1996). Foundations of electrical engineering (Latest Edition). Prentice Hall.