ELECTRONICS CIRCUITS

ENEX 154

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

Course Objectives:
To introduce the fundamentals of analysis of electronic circuits and to provide basic understanding of semiconductor devices and analog integrated circuits.

1 Diodes (6 hours)

1.1 Physical operation of semiconductor diode characteristics
1.2 Large signal and small signal model of the semiconductor diode
1.3 Zener diode, LED, photodiode, varactor diode, tunnel diodes
1.4 DC power supply: Half wave rectifier, full wave (Center tapped, bridge) rectifier

2 The Bipolar Junction Transistor (9 hours)

2.1 Operation of the npn transistor in the active mode
2.2 Graphical representation of transistor characteristic
2.3 Analysis of transistor circuits at DC
2.4 Graphical DC load line analysis
2.5 Biasing BJT for discrete-circuit design
2.6 Small signal equivalent circuit models of BJT (π & T)
2.7 Transistor as an amplifier (r_{π}, r_e, g_m)
2.8 Basic single-stage BJT amplifier configuration (C-E)
2.9 Small signal analysis of C-E amplifier
2.10 Transistor as a switch – Cutoff and saturation
2.11 A general large-signal model of the BJT: The Ebers-Moll model

3 Field-Effect Transistor (9 hours)

3.1 Structure and physical operation of the junction field-effect transistor
3.2 Structure and physical operation of enhancement-type MOSFET
3.3 Current-voltage characteristic of enhancement-type MOSFET
3.4 The depletion-type MOSFET
3.5 MOSFET circuits at DC
3.6 Biasing in MOS amplifier circuits
3.7 MOSFET as an amplifier (common source)
3.8 MOSFET and CMOS as logic circuits

4 The Operational Amplifier and Oscillator (6 hours)

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

5 Output Stages and Power Amplifiers (9 hours)

5.1 Classification of output stages
5.2 Class A output stage
5.3 Class B output stage
5.4 Class AB output stage
5.5 Biasing of class AB output stage
5.6 Power BJT's
5.7 Transformer-coupled push-pull stage
5.8 Tuned amplifiers

6 Power Supplies, Breakdown Diodes, and Voltage Reference (6 hours)

6.1 Unregulated power supply
6.2 Zener regulated power supply
6.3 Zener diodes, bandgap voltage reference, constant current diodes
6.4 Transistor shunt/series voltage regulator
6.5 Improving voltage regulator performance with feedback
6.6 IC voltage regulator

Tutorial (15 hours)

The tutorial sessions will focus on chapter-specific exercises aimed at enhancing understanding and application in electronics circuits.

Practical (45 hours)

1. Familiarization with passive components, function generator and oscilloscope
2. Measurement of amplitude, frequency, time period using oscilloscope
3. Diode characteristics, rectifiers, Zener diodes
4. Bipolar junction transistor characteristics and single stage amplifier
5. Power amplifiers
6. Field effect transistor characteristics and single stage amplifier
7. BJT, PMOS, NMOS and CMOS as switch
8. Inverting, non-inverting, summing and subtractor amplifier using Op-amp
9. Relaxation oscillator and sinusoidal oscillator
10. IC, series and shunt voltage regulators
11. Project presentation

Final Exam

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	Hours	Mark distribution*
1	6	8
2	9	12
3	9	12
4	6	8
5	9	12
6	6	8
Total	**45**	**60**

* There may be minor deviation in marks distribution.

References

1. Sedra, A.S., Smith, K.C. (2010). Microelectronic circuits. Oxford University Press.
2. Boylestad, R.L., Nashelsky, L. (2009). Electronic devices and circuit theory. Pearson Education.
3. Floyd, T.L. (2007). Electronic devices. Pearson Prentice Hall.
4. Millman, J., Halkias, C., Parikh, C.D. (2010). Integrated electronics: Analog and digital circuits and systems. McGraw-Hill Education.
5. Bell, D.A. (2008). Fundamentals of electronic devices and circuits. Oxford University Press.