ELECTRONIC DEVICE AND CIRCUITS

ENEX 151

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 The Bipolar Junction Transistor (BJT) (9 hours)

1.1 Review of operation of the npn transistor in the active mode
1.2 Review of graphical representation of transistor characteristics
1.3 Analysis of transistor circuits at DC
1.4 Graphical DC load line analysis
1.5 Transistor as an amplifier (r_π, r_e, g_m)
1.6 Biasing BJT for discrete-circuit design
1.7 Small signal equivalent circuit models (π and T)
1.8 Basic single-stage BJT amplifier configuration (C-B, C-E, C-C)
1.9 Small signal analysis of amplifier
1.10 Transistor as a switch – cutoff and saturation
1.11 A general large-signal model of the BJT: The Ebers-Moll model

2 Field-Effect Transistor (10 hours)

2.1 Structure and physical operation of the junction field-effect transistor
2.2 Structure and physical operation of enhancement-type MOSFET
2.3 Current-voltage characteristic of enhancement-type MOSFET
2.4 The depletion-type MOSFET
2.5 Biasing in MOS amplifier circuits
2.6 MOSFET circuits at DC
2.7 MOSFET as an amplifier (Common source)
2.8 MOSFET and CMOS as logic circuits

3 Operational Amplifier Circuits and Oscillator (10 hours)

3.1 Review of basic principles of sinusoidal oscillator
3.2 Review of Op-Amp square and triangular, RC oscillator circuits
3.3 LC and crystal oscillators
3.4 Integrated circuit timers
3.5 Precision rectifier circuits
3.6 Bias circuits suitable for IC design
3.7 The Widlar current source

3.8 The differential amplifier
3.9 Active loads
3.10 Output stages

4 Output Stages and Power Amplifiers (10 hours)

4.1 Classification of output stages
4.2 Class A output stage
4.3 Class B output stage
4.4 Class AB output stage
4.5 Biasing of class AB output stage
4.6 Power BJT's
4.7 Transformer-coupled push-pull stage
4.8 Tuned amplifiers

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

5.1 Unregulated power supply
5.2 Zener regulated power supply
5.3 Zener diodes, bandgap voltage reference, constant current diodes
5.4 Transistor shunt/series voltage regulator
5.5 Improving voltage regulator performance with feedback
5.6 IC voltage regulator

Tutorial (15 hours)

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

Practical (45 hours)

1. Diode characteristics, rectifiers, Zener diodes
2. Bipolar junction transistor characteristics and single stage amplifier
3. BJT single stage amplifier (Rin, Rout, Gain)
4. Power amplifiers
5. Field effect transistor characteristics
6. FET single stage amplifier
7. BJT differential amplifier
8. Relaxation oscillator and sinusoidal oscillator (Phase shift, Wien bridge)
9. Series, shunt and IC voltage regulators
10. Multivibrator using 555 timer IC
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	9	12
2	10	13
3	10	13
4	10	13
5	6	9
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. (2013). Electronic devices and circuit theory. Pearson.
3. Floyd, T. L. (2013). Electronic devices. Pearson Education Limited.
4. Millman, J., Halkias, C., Parikh, C.D. (2010). Integrated electronics: Analog and digital circuits and systems. Tata McGraw-Hill Education.
5. Bell, D.A. (2009). Electronic devices and circuits. Oxford University Press.