204182 Electronic Devices And Circuits

Teaching Scheme:
Lectures: 4 Hrs/ Week
Practical: 2 Hrs/Week

Examination Scheme:
Theory Online : 50 Marks
Theory Paper : 50 Marks
Practical: 50 Marks

Course Objectives and Outcomes:

The objective of the course is to introduce the students to semiconductor devices (such as BJT, MOSFET) and their characteristics, analysis, operation, circuits and applications.

Having successfully completed this course, the student will be able to:

1. Understand and apply basic and semiconductor principles to the device to observe its performance.
2. Comply and verify parameters after exciting devices by any stated method.
3. Simulate electronics circuits using computer simulation software to obtain desired results.
4. Understand and verify simulated circuit with hardware implementation.
5. Implement hardwired circuit to test performance and application for what it is being designed.
6. Analyze and model BJT and MOSFET for small signal.
7. Understand and apply concept of feedback to improve stability of circuits.
8. Understand behavior of transistors at low and high frequency.

Unit I : Bipolar Junction Transistors DC Circuits **6L**

The Operating Point, Bias Stability, Self Bias or Emitter Bias, Stabilization against Variations in I_{CO}, V_{BE} and β, General Remarks on Collector – Current Stability, Bias Compensation Techniques, Thermal Runaway, Thermal Stability.

Unit II : BJT at Low Frequencies **8L**

Two Port Devices and the Hybrid Model, Transistor Hybrid Model, Small Signal Amplifier Performance in terms of h-parameters, exact analysis of BJT CE, Comparison of CE, CC & CB Amplifier's performance parameters, High Input Impedance Transistor Circuits

Unit-III Frequency Response of Amplifiers & BJT at High Frequency 8L

Frequency Response of an Amplifier, Step Response of an Amplifier, Bandpass of Cascaded Stages, RC-Coupled Amplifier, Low-Frequency Response of an RC-Coupled Stage, The Hybrid-π Common-Emitter Transistor Model, Hybrid-π Conductances, The Hybrid-π Capacitances, The CE Short-Circuit Current Gain, Current Gain with Resistive Load

Unit IV : Feedback amplifiers and Oscillators 8L

The Feedback Concept, The Transfer gain with Feedback, General Characteristics of Negative-Feedback Amplifiers, Topologies of Negative-Feedback, Summery of Effect of Negative-Feedback on Gain, Input Resistance , Output Resistance & Bandwidth of Amplifier, Sinusoidal Oscillators, The Transistor Phase-Shift Oscillator, A General form of LC Oscillator Circuit, Transistor Hartley & Colpitts Oscillator

Unit V : Large Signal Low Frequency Amplifiers 6L

Power BJTs, Classification of Amplifies, Class A Large-Signal Amplifiers, Second –Harmonic Distortion, The Transformer-Coupled Audio Power Amplifier & it's Efficiency, Class B Amplifiers, Class B Push-Pull & Complementary-Symmetry Amplifier, Class AB Operation

Unit VI : E-MOSFET's DC & AC Circuits 8L

Non-ideal voltage current characteristics of EMOSFET. Biasing of EMOSFET Common source circuit, Load Line & Modes of operation, DC Analysis, constant current source biasing. Small Signal Parameters, Small Signal Equivalent Circuit, Analysis of CS amplifier. Introduction to Bi-CMOS Technology. The E-MOSFET internal capacitances and high frequency model.

Text Books :

1. Millman, Halkias, "Integrated Electronics- Analog and Digital Circuits and Systems", 2nd TMH.
2. Donald Neamaen, "Electronic Circuit Analysis and Design", 3rd Edition, TMH.

Reference Books :

1. David A.Bell, "Electronic Devices and Circuits", 5th Edition, Oxford press
2. Boylstad, Nashlesky, "Electronic Devices and Circuits Theory", 9th Edition, PHI, 2006.
3. Sedra Smith, "Microelectronics Circuits, 5th Edition, Oxford, 1999.

List of Experiments:

Exp no.	Name of experiment	Practical Turns
1	Build and test a sensing circuit for slotted disc using photo diode/ Optocoupler [H 21 A 1] in RPM indicator. • Identify the terminal of optical device. • Relevance of slot and speed. • Measure RPM using oscilloscope/frequency counter.	1
2	Transistor as a switch to drive LED, relay and single seven segment display (common Anode) use BC547. • Measure I_C and V_{CEsat} for each drive. • To find critical input current required to operate switch (On/Off). • Justification for why CB and CC configuration are not preferred as an electronic switch.	1
3	Verify DC operating point for a single stage BJT in CE configuration. • Calculate values biasing resistors (R_1,R_2,R_E) to operate BJT at a certain V_{CEQ} & I_{CQ} • Build the circuit with these components • Measure V_{CEQ}, I_{CQ}, I_{BQ} and V_{BEQ} • Compare measured quantities with theoretical values	2
4	Build and test single stage CE amplifier. • Use the circuit build in Experiment No. 3 • Connect coupling and emitter bypass capacitors • To measure the voltage gain, input resistance (R_i), output Resistance (R_o) of the amplifier. • Verify phase difference between input and output voltage. • To measure the bandwidth using square wave testing.	1
5	Simulate a Single stage BJT amplifier (CE, CB and CC) for given	1

	specifications.(DC & AC Analysis) • Implement the circuit build in Experiment No. 4 in simulation software. • To measure the voltage gain (A_V), input resistance (R_i), output Resistance (R_O) of the CE, CB and CC amplifier. • To observe and print input and output waveforms to understand the phase difference in each configuration.	
6	Simulate frequency response of single stage CE amplifier (use same circuit) • To study the effect of coupling capacitor and bypass capacitor on low frequency response. • To study effect of external shunting capacitor on high frequency response (To restrict bandwidth). • To understand dominant RC circuit for f_L and f_H.	1
7	Voltage-Series feedback amplifier • To identify topology of feedback with proper justification. • To measure voltage gain, input resistance, output resistance and bandwidth (using square wave testing) for without feedback. • To measure voltage gain, input resistance, output resistance and bandwidth (using square wave testing) for with feedback. • To verify the improvement in various parameters as per the derived equations.	2
8	Simulation of current shunt feedback amplifier • To identify topology of feedback with proper justification. • To measure current gain, input resistance, output resistance and bandwidth for without feedback. • To measure current gain, input resistance, output resistance and bandwidth for with feedback. • To verify the improvement in various parameters as per the derived equations.	1
9	Simulation of transistorized oscillator • Implement the Phase shift oscillator. • Verify Barkhausen criteria. • Implement the crystal oscillator (series / parallel resonance circuit). • To observe the output voltage waveform. • To calculate frequency of oscillation theoretically and practically.	1
10	Build & Test transistorized oscillator	1

- Implement the LC (Colpitts / Hartley) oscillator.
- Verify Barkhausen criteria.
- To observe the output voltage waveform.
- To calculate frequency of oscillation theoretically and practically.

11 Complementary Symmetry push pull amplifier

- To verify DC condition
- To understand class of operation.
- To calculate the percentage conversion efficiency.
- To calculate power dissipation of both transistor.
- To observe and elimination of crossover distortion.

1

12 MOSFET as a switch (CD4007C)

- NMOS switch with Ohmic load.
- CMOS inverter.

1

Realization of NAND using PMOS and NMOS.

Note: Conduct Experiment 7 OR 8 and 9 OR 10.