

Electronic Devices and Circuits

UNIT I: JFET

Introduction to JFET, Types, Construction, Operation, Static Characteristics, Pinch off voltage, FET Volt-Ampere characteristics, FET Configurations (CS/CD/CG) and their Comparison. Biasing of FET (Self). FET as an amplifier and its analysis (CS) and its frequency response. Small signal model, FET as High Impedance circuits.

Unit II :MOSFET& its DC Analysis

Basics of MOS Transistor operation, Construction of n-channel E-MOSFET, E-MOSFET characteristics & parameters, non-ideal voltage current characteristics viz. Finite output resistance, body effect, sub-threshold conduction, breakdown effects and temperature effects. Common source circuit, Load Line & Modes of operation, common MOSFET configurations: DC Analysis, constant current source biasing.

Unit III : MOSFET AC Circuit Analysis:

The MOSFET CS small signal amplifier, Small signal parameters, small signal equivalent circuit, Modeling, Body effect, Analysis of CS amplifier. Introduction to BiCMOS technology. The MOSFET internal capacitances and high frequency model. Introduction to MOSFET as basic element in VLSI, V-I characteristic equation in terms of W/L ratio, MOSFET scaling and small geometry effects, MOSFET capacitances.

Unit IV : MOSFET Circuits

MOSFET as switch, diode/active resistor, Current sink and source, current mirror, Voltage references, Basic principle of band gap reference, CMOS Inverter as amplifier: Active load, Current source and Push pull configurations.

Unit V : Feedback amplifiers and Oscillators

Four types of amplifiers. Feedback topologies. Effect of feedback on terminal characteristics of amplifiers. Examples of voltage series and Current series FET feedback amplifiers and their analysis. Barkhausen criterion, stability with feedback. General form of LC oscillator. FET RC Phase Shift oscillator, Wein bridge oscillator, Hartley and Colpitts oscillators.

Unit VI :Voltage Regulator:

Block diagram of an adjustable three terminal positive and negative regulators (317,337).Typical connection diagram, current boosting,Fixed and Adjustable Voltage Regulators , Low drop out voltage regulators. Low Drop out (LDO) Regulators ICs- TPS7A4901, TPS7A8300, TPS7250; Introduction to Switch Mode Power supply (SMPS), Block diagram of SMPS, Types of SMPS,

Basic Switching Regulator and characteristics of standard regulator ICs –TPS40200, TPS40210, Comparison of Linear Power supply and SMPS.

Text Books:

1. Millman Halkias, “Integrated Electronics-Analog and Digital Circuits and Systems”, Tata McGraw Hill, 2000.
2. Donald Neuman, “Electronic Circuit Analysis and Design”, 3rd Edition, Tata McGraw Hill.

Reference:

1. David A. Bell, “Electronic Devices and Circuits”, 5th Edition, Oxford press
2. R. L. Boylstad, L. Nashlesky, “Electronic Devices and Circuits Theory”, 9th Edition, Prentice Hall of India, 2006.
3. Anil K. Maini and Varsha Agarwal “Electronic Devices and Circuits”, Wiley India
4. Phillip E. Allen, Douglas R. Holberg, “CMOS Analog Circuit Design”, Second Edition, Oxford.
5. K. R. Botkar, “Integrated Circuits”, 5th Edition, Khanna Publication.

Other References:

1. TPS40200: <http://www.ti.com.cn/cn/lit/ds/symlink/tps40200.pdf>
2. TPS40210: <http://www.ti.com/lit/ds/symlink/tps40210.pdf>
3. TPS7A4901: <http://www.ti.com/lit/ds/symlink/tps7a49.pdf>
4. TPS7A8300: <http://www.ti.com/lit/ds/symlink/tps7a8300.pdf>

List of Practical

Lab Setup Requirement:

Dual Channel Cathode Ray Oscilloscope (0-20 MHz), Function Generator (10MHz and above), Dual Power Supply , ASLKPRO, standard regulator ICs – TPS40200, TPS7250, PMLK LDO ,TPS 7A4901, TPS7A8300, Clip Probes, digital multimeter.

1. Design a single stage FET Amplifier in CS configuration and verify DC operating point.
2. Build and test single stage CS amplifier using FET. Calculate R_i , R_o and A_v .
3. Simulate frequency response of single stage CS amplifier (use same circuit) and find the bandwidth.
4. Simulate Voltage-Series feedback amplifier and calculate R_{if} , R_{of} , A_{vf} and Bandwidth.
5. Implement current series feedback amplifier and find R_{if} , R_{of} , G_{mf} and Bandwidth.
6. Simulate LC oscillator using FET. OR
7. Implement Weinbridge /RC phase shift oscillator using FET/MOSFET.
8. Simulate MOSFET/ CMOS Inverter. OR
9. Build and test MOSFET as a switch.
10. Design and implement an adjustable voltage regulator using three terminals voltage regulator
11. Design and test a Low Dropout regulator using op-amps for a given voltage regulation characteristic and compare the characteristics with TPS7250 IC
12. Design of a switched mode power supply that can provide a regulated output voltage for a given input range and compare the characteristics using the TPS40200 IC.

13. With TPS7A4901 and TPS7A8300, study-
- a. Impact of line and load conditions on drop out voltage
 - b. Impact of line and load conditions on efficiency
 - c. Impact of capacitor on PSRR
 - d. Impact of output capacitor on load-transient response

Reference Material:

1. ASLK Pro Manual: <http://download.mikroe.com/documents/specials/educational/aslk-pro/aslk-pro-manual-v103.pdf>
2. PMLK LDO Lab manual - <http://www.ti.com/lit/ug/ssqu006/ssqu006.pdf>