EC 6304 ELECTRONIC CIRCUITS – I

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OBJECTIVE

The student should be made to

•Learn about biasing of BJTs and MOSFETs
•Design and construct amplifiers
•Construct amplifiers with active loads
•Study high frequency response of all amplifiers

UNIT I BIASING OF DISCRETE BJT AND MOSFET 9

DC Load line, operating point, Various biasing methods for BJT-Design-Stability-Bias compensation, Thermal stability, Design of biasing for JFET, Design of biasing for MOSFET.

UNIT II BJT AMPLIFIERS 9

Small signal Analysis of Common Emitter-AC Loadline, Voltage swing limitations, Common collector and common base amplifiers – Differential amplifiers- CMRR- Darlington Amplifier-Bootstrap technique - Cascaded stages - Cascode Amplifier.

UNIT III JFET AND MOSFET AMPLIFIERS 9

Small signal analysis of JFT amplifiers- Small signal Analysis of MOSFET and JFET, Common source amplifier, Voltage swing limitations, Small signal analysis of MOSFET and JFET Source follower and Common Gate amplifiers, - BiMOS Cascode amplifier.

UNIT IV FREQUENCY ANALYSIS OF BJT AND MOSFET AMPLIFIERS 9

Low frequency and Miller effect, High frequency analysis of CE and MOSFET CS amplifier, Short circuit current gain, cut off frequency – fα and fβ unity gain and Determination of bandwidth of single stage and multistage amplifiers.

UNIT V IC MOSFET AMPLIFIERS 9

IC Amplifiers- IC biasing Current steering circuit using MOSFET- MOSFET current sources-PMOS and NMOS current sources. Amplifier with active loads - enhancement load, Depletion load and PMOS and NMOS current sources load- CMOS common source and source follower-CMOS differential amplifier- CMRR.

TOTAL (L: 45+T: 15): 60 PERIODS

OUTCOMES:

Upon Completion of the course, the students will be able to:

•Design circuits with transistor biasing.
•Design simple amplifier circuits.
•Analyze the small signal equivalent circuits of transistors.
•Design and analyze large signal amplifiers.

TEXT BOOK

1.Donald .A. Neamen, Electronic Circuit Analysis and Design –2nd Edition, Tata Mc Graw Hill, 2009.

REFERENCES

1.Adel .S. Sedra, Kenneth C. Smith, “Micro Electronic Circuits”, 6th Edition, Oxford University Press, 2010.
2.David A., “Bell Electronic Devices and Circuits”, Oxford Higher Education Press, 5th Editon, 2010
3.Behzad Razavi, “Design of Analog CMOS Integrated Circuits”, Tata Mc Graw Hill, 2007.
4.Paul Gray, Hurst, Lewis, Meyer “Analysis and Design of Analog Integrated Circuits”, 4thEdition ,John Willey& Sons 2005.
5.Millman.J. and Halkias C.C, “Integrated Electronics”, Mc Graw Hill, 2001.
6.D.Schilling and C.Belove, “Electronic Circuits”, 3rd Edition, Mc Graw Hill, 1989.

DHANALAKSHMI SRINIVASAN COLLEGE OF ENGINEERING AND TECHNOLOGY

EC6304 - ELECTRONIC CIRCUITS - I

BE-ECE/ SEMESTER III **REGULATION 2013**

Faculty Name: S.Kalpana, AP/ECE

QUESTION BANK

UNIT I BIASING OF DISCRETE BJT AND MOSFET

PART –A

1.Why do we choose Q point at the center of the load line?
2.Name the two techniques used in the stability of the q point .explain.
3.Give the expression for stability factor.
4.List out the different types of biasing.
5.What do you meant by thermal runway?
6.Why the transistor is called a current controlled device?
7.Define current amplification factor?
8.What are the requirements for biasing circuits?
9.When does a transistor act as a switch?
10.What is biasing?
11.What is operating point?
12.What is stability factor?
13.What is DC load line?
14.What are the advantages of fixed bias circuit?
15.Explain about the various regions in a transistor?
16.Explain about the characteristics of a transistor?
17.What is the necessary of the coupling capacitor?
18.What is reverse saturation current?
19.Why is the operating point selected at the Centre of the active region?
20.What are the basic rules of an operating amplifier?

PART –B

1.Explain the voltage divider bias method & derive an expression for stability factors.

2.Why biasing is necessary in BJT amplifier? Explain the concept of DC & AC load line withneat diagram. How will you select the operating point, explain it using CE amplifiercharacteristics?

3.Explain the collector feedback bias amplifier & derive an expression for stability factors.

4.Explain the fixed bias method & derive an expression for stability factors.

5.Derive an expression for all stability factors & CE configuration S equation.

6.Explain about common source self- bias & voltage divider bias for FET.

7.Explain in details about biasing MOSFET.

8.Discuss the various types of bias compensation.

9.The fixed bias circuit as shown in figure is subjected to an increase in junction temperaturefrom 25°C to 75°C. If β is 125 at 75°C. Determine the percentage change in Q point values(V_{ce}, I_c) over temperature change. Neglect any change in V_{BE}.

10.A self bias circuit has R_E=1 kΩ, R_1=130 kΩ, R_2=10 kΩ. If V_{cc} and R_c are adjusted to giveI_c=1mA at 10°C. Calculate the variation in I_c over temperature change of 10°C to 100°C.The transistor used has the parameters given below,

Parameters	10°C	100°C
I_{CO}(A)	0.01	1.2
V_{BE}(V)	0.74	0.54
β	60	140

11. Design a collector to base bias circuit to have operating point (10v, 4mA). The circuit is supplied with 20v and uses a silicon transistor of h_{fe} is 250.

12. Design a voltage divider bias circuit for the specified conditions. V_{CC}=12v, V_{CE}=6v, I_C=1mA, S=20, β=100 and V_E=1v.

UNIT II BJT AMPLIFIERS

PART –A

1. What is an amplifier?
2. How are amplifiers classified according to the input?
3. How are amplifiers classified according to the transistor configuration?
4. What is the different analysis available to analyze a transistor?
5. How can a DC equivalent circuit of an amplifier be obtained?
6. How can an AC equivalent circuit of an amplifier be obtained?
7. Define Common Mode Rejection Ratio.
8. State Miller's Theorem.
9. What are the various h-parameters for a CE transistor?
13. What is the typical value of CMRR? How the constant current circuit is used to improve the CMRR?
10. Find the value of α_{dc} when Ic=8.2mA and Ie=8.7mA.
11. What are the benefits of h-parameters?
12. What is the coupling schemes used in multistage amplifiers?
13. What is the role of coupling network in multistage amplifiers?
14. Define voltage & current gain of an emitter follower.
15. What is meant by power gain?
16. What does bootstrapping mean?
17. Why bootstrapping is done in a buffer amplifier?
18. Draw the Darlington emitter follower circuit.
19. Why CE amplifier better than CC & CB amplifiers?
20. What is the difference between cascade and cascode amplifier?

PART –B

1. Draw a CE amplifier & its small signal equivalent. Derive its A_{vs}, A_i, R_{in}, R_o.
2. Explain with circuit diagram of Darlington connection and derive the expression for A_i, A_v, R_i &R_o.
3. Explain Bootstrap emitter follower circuit. Compare CE, CB, CC amplifiers.
4. Derive expression for voltage gain of CS & CD amplifier under small signal low frequency condition.
5. Explain the emitter coupled differential amplifier with neat diagram & Derive expression for CMRR.
6. Discuss transfer characteristics of differential amplifier. Explain the methods used to improve CMRR.
7. Write short notes on multistage amplifiers & Draw a two stage RC coupled amplifier and explain. Compare cascade and cascode amplifier?
8. Derive the expressions for the voltage gain, current gain, input and output impedance of emitter follower amplifier.

9. Derive the expressions for the common mode and differential mode gains of a differential amplifier in terms of h-parameters.
10. Consider a single stage CE amplifier with R_s=1kΩ, R_1=50KΩ, R_2=2KΩ, R_C=2KΩ, R_L=2KΩ, h_{fe}=50, h_{ie}=1.1 KΩ, h_{oe}=25μmho, h_{re}=2.5×10^{-4}. Find A_i,R_i,A_v,A_{is},A_{vs} and R_0.
11. The Darlington amplifier has the following parameters, R_s=3kΩ, R_E=3kΩ, h_{ie}=1.1 KΩ, h_{fe}=50, h_{re}=2.5×10^{-4}, h_{oe}=25μmho. Then calculate A_i, R_i, A_v and R_0.
12. The dual input balanced output differential amplifier having R_s=100Ω, R_C=4.7KΩ, R_E=6.8KΩ, h_{fe}=100, V_{cc}=+15v and V_{EE}=-15v. Calculate operating point values, differential & common mode gain, CMRR, and output if V_{S1}= 70mV(p-p) at 1 KHz & V_{S2}= 40mV(p-p) at 1 KHz

UNIT III JFET AND MOSFET AMPLIFIERS

PART –A

1. What is meant by small signal?
2. What is the physical meaning of small signal parameter r_o?
3. Write the equation for small signal condition that must be satisfied for linear amplifiers.
4. Draw the small signal equivalent circuit common source NMOS.
5. What is another name for common drain amplifier?
6. Draw the source follower amplifier circuit.
7. List the applications of MOSFET amplifiers.
8. Compare the characteristics of three MOSFET amplifier configurations.
9. Draw the small signal equivalent JFET common source circuit.
10. How does a transistor width-to-length ratio affect the small signal voltage gain of a common source amplifier?
11. How a MOSFET can be used to amplify a time varying voltage?
12. How does body effect change the small signal equivalent of the MOSFET?
13. Why in general the magnitude of the voltage gain of a common source amplifier relatively small?
14. What is voltage swing limitation?
15. What is the general condition under which a common gate amplifier would be used?
16. State the general advantage of using transistors in place of resistors in integrated circuits.
17. Give one reason why a JFET might be used as an input device in a circuit as proposed to a MOSFET.
18. What are features of cascode amplifiers?
19. What are the applications of BiCMOS?
20. Discuss one advantage of BiCMOS circuit.

PART –B

1. Describe the operation and analyze the basic JFET amplifier circuits.
2. Derive the small signal analysis of common source amplifier.
3. Develop a small signal model of JFET device and analyze basic JFET amplifiers.
4. Explain graphically the amplification process in a simple MOSFET amplifier circuit.
5. Describe the small signal equivalent circuit of the MOSFET and determine the values of small signal parameters?
6. Sketch the small signal high frequency circuit of a common source amplifier & derive the expression for a voltage gain, input & output admittance and input capacitance.
7. Sketch a simple source-follower amplifier circuit and discuss the general ac circuit characteristics.
8. Characterize the voltage gain and output resistance of a common-gate amplifier.

9. Apply the MOSFET small signal equivalent circuit in the analysis of multistage amplifier circuits.

10. Explain common source amplifier with source resistor and source bypass capacitor.

11. Write short notes Voltage swing limitations, general conditions under which a source follower amplifier would be used.

12. Describe the characteristics of and analyze BiCMOS circuits.

UNIT IV FREQUENCY ANALYSIS OF BJT AND MOSFET AMPLIFIERS

PART –A

1. Draw the frequency response curve of an amplifier.
2. What is the bandwidth of an amplifier?
3. Define rise time.
4. What kind of techniques required increasing the input impedance?
5. Give relation between rise time and bandwidth.
6. Give the main reason for the drop in gain at the low frequency region & high frequency region.
7. If the rise time of BJT is 35nS, what is the bandwidth that can be obtained using this BJT?
8. For an amplifier, mid band gain is 100 & lower cutoff frequency is 20KHz. Find the gain of an amplifier at frequency 20Hz.
9. For an amplifier, 3dB gain is 200 & higher cutoff frequency is 20KHz. Find the gain of an amplifier at frequency 100KHz.
10. Why common base amplifier is preferred for high frequency signal when compared to CE amplifier?
11. Draw the hybrid π equivalent circuit of BJTs.
12. What is the difference between small signal equivalent & hybrid π equivalent circuit.
13. What is high frequency effect?
14. What are the causes for occurrence of upper cutoff frequency in BJT?
15. What is Miller's effect? What is gain bandwidth product?
16. Give equation of overall lower and upper cutoff frequency of multistage amplifier.
17. What is significance of octaves and decades in frequency response?
18. What are the causes for occurrence of upper cutoff frequency in BJT?
19. What is the major contribution to the Miller capacitance in a MOSFET?
20. Define cut off frequency for a MOSFET.

PART –B

1. With neat sketch explain hybrid π CE transistor model. Derive the expression for various components in terms of 'h' parameters.

2. Discuss the frequency response of multistage amplifiers. Calculate the overall upper & lower cutoff frequencies.

3. Discuss the low frequency response & the high frequency response of an amplifier. Derive its cutoff frequencies.

4. Discuss the terms rise time and sag.

5. Write short notes on high frequency amplifier.

6. Derive the gain bandwidth for high frequency FET amplifiers.

7. Derive the expression for the CE short circuit current gain of transistor at high frequency

8. What is the effect of $C_{b'e}$ on the input circuit of a BJT amplifier at High frequencies? Derive the equation for g_m which gives the relation between g_m, I_c and temperature.

9. Explain the high frequency analysis of JFET with necessary circuit diagram & gain bandwidth product.

10. Discuss the frequency response of MOSFET CS amplifier.

11. Determine the bandwidth of CE amplifier with the following specifications. R_1=100kΩ, R_2=10kΩ, R_C=9kΩ, R_E=2kΩ, C_1= C_2=25μF, C_E=50μF, $r_{bb'}$=100Ω, $r_{b'e}$=1.1KΩ, h_{fe}=225,

$C_{b'e}$=3pF and $C_{b'c}$=100pF.

12. At I_c=1mA & V_{CE}=10v, a certain transistor data shows C_c=$C_{b'c}$=3pF, h_{fe}=200, & ω_T=-500M rad/sec. Calculate gm, $r_{b'e}$, C_e=$C_{b'e}$ & ω_β.

UNIT V IC MOSFET AMPLIFIERS

PART –A

1. What are the basic processes in integrated circuit fabrication?
2. Define common mode rejection ration? What is the ideal value?
3. Sketch the DC transfer characteristics of a MOSFET differential amplifier.
4. What are the advantages of an active load?
5. What is the impedance seen looking into a simple active load?
6. How the reference portion of the circuit can be designed with MOSFETs only.
7. How should a MOSFET be biased so as to operate as a stable current source?
8. Draw the circuit of MOSFET differential amplifier with active load.
9. What is the need for MOSFET differential amplifier with cascode active load?
10. What is meant by matched transistors?
11. Define common mode and differential mode input resistance and voltages.
12. What are the limiting factors for the maximum current in MOSFET?
13. Define enhancement and depletion mode of MOSFET.
14. Define saturation and non- saturation bias regions.
15. How do you prove that a MOSFET is biased in the saturation region?
16. Draw MOSFET cascode current source circuit.
17. What is another name of two transistor current source?
18. Draw the two transistor MOSFET current source.
19. What is Widlar current source
20. What is cascode current mirror?

PART –B

1. Describe the operation of an NMOS amplifier with either an enhancement load, a depletion load, or a PMOS load.

2. Explain the basic MOSFET two transistor current circuits and discuss its operation.

3. Draw the MOSFET cascode current source circuit, explain and discuss the advantage of this design.

4. Sketch and describe the advantages of a MOSFET cascode current source used with a MOSFET differential amplifier.

5. Design a CMOS differential amplifier with an output gain stage to meet a set of specifications. The magnitude of voltage gain of each stage is to be at least 600. Bias currents are to be I_Q=I_{REF}=100μA, and biasing of the circuit is to be V_+=2.5 v and V_-=2.5 v.

6. Explain CMOS differential amplifier and derive CMRR.

7. Draw a Widlar current source and explain the operation.
8. Describe the operation of a PMOS amplifier with an enhancement load, a depletion load.
9. Explain the CMOS common source and source follower with neat diagram.
10. Explain the large signal behavior of MOSFETs and compare the operating regions of Bipolar and MOS transistors.
11. Discuss the operation of active load and discuss the advantages of MOSFET cascode current circuit.
12. Explain in detail about CMOS common source and source follower with neat diagram.