In this chapter, we will:

- Analyze and understand the characteristics of various bipolar circuits used to provide a constant output current.
- Analyze and understand the characteristics of various MOSFET (and a few JFET) circuits used to provide a constant output current.
- Analyze the dc characteristics of amplifier circuits using transistors as load devices (active loads).
- Analyze the small-signal characteristics of amplifier circuits with active loads.
- Design an NMOS current source circuit to provide a specified bias current and output resistance.
2-Transistor Current Source

DC Equivalent Circuit:
2-Transistor Current Source
3-Transistor Current Source

Bipolar Cascode Current Mirror
Other Current Source

Wilson

Widlar

Problem-Solving Technique: BJT Current Source Circuits

1. Sum currents at various nodes to find relation between reference and bias currents
2. Place test voltage at output node and analyze small-signal equivalent circuit to find output resistance.
   a. Reference current is a constant
      i. Some base voltages may be constant or at ac ground.
Multitransistor and Multioutput Current Mirror

Generalized Current Mirror
MOSFET Current Source

MOSFET Cascode Current Source
Equivalent Circuits for MOSFET Cascode Current Mirror

MOSFET Wilson Current Source
Bias-Independent MOSFET Current Mirror

BJT Amplifier with Active Load
Characteristics of Bipolar Circuit with Active Load

MOSFET Amplifier with Active Load
Driver Characteristics: 
MOSFET Amplifier with Active Load

Small-Signal Equivalent Circuit: 
BJT Active Load
Problem-Solving Technique: BJT Active Loads

1. Ensure active load devices are biased in forward active mode.
2. Small-signal analysis considers output resistance looking back into output of active load device as well as the equivalent circuit of amplifying transistor.

Small-Signal Equivalent Circuit: MOSFET Active Load
MOSFET Cascode Amplifier with Cascode Active Load