BENHA UNIVERSITY
FACULTY OF ENGINEERING AT SHOUBRA

ECE-312

Electronic Circuits (A)

Lecture #1
Introduction and Basic Concepts

Instructor:

Dr. Ahmad El-Banna

OCTOBER 2014

Agenda

- Course Objectives
- Course Information
- Lectures List
- Basic Concepts

Course Objectives

- ***Understand the transistor biasing, modeling, and its small-signal analysis.***
- ***Analyze the transistor circuits at low, medium and high frequencies and study its frequency response using bode plots.***
- ***Explain the operation of tuned amplifiers and power amplifiers.***
- ***Learn the difference between amplifiers and oscillators and study the oscillator circuits.***
- ***Study the mixers and modulators circuits.***

Course Information

Instructor:	Dr. Ahmad El-Banna https://www.linkedin.com/pub/ahmad-el-banna/32/6a3/495 Office: Room #306 Email: ahmad.elbanna@feng.bu.edu.eg ahmad.elbanna@ejust.edu.eg
Lectures:	Tuesday :14:00-15:30 Wednesday: 12:30 -14:00 Prerequisite: ECE-121 & ECE-222
Office Hours:	Sunday(10:30~11:30),Tuesday(14:00~16:30)&Wednesday (14:00~16:30)
T.A.:	Eng. Heba Adly
Texts/Notes:	• Lectures slides, available by each lecture, and found online at https://speakerdeck.com/ahmad_elbanna • R. Boylestad, **Electronic Devices and Circuit Theory**, 11th edition, Prentice Hall. • T. Floyd, **Electronic devices** - Conventional Current Version, 9th edition, Prentice Hall.

Course Information..

Additional References:	• Sedra & Smith, **Microelectronic Circuits**, 6th edition. • Horowitz & Hill, **The Art of Electronics**, 2nd edition, Cambridge Press. • EE113 Course Notes Electronic Circuits by Prof. G. Kovacs, Stanford University ,Department of Electrical Engineering.
Credit:	150 Marks

Grading:	▪ **60%**
	  • Final Exam (Closed-Book)
	▪ **20%**
	  • Mid Term Exam (Open-Book) (10%)
	  • Homework and tutorials activities (10%)
	▪ **20%**
	  • Individual Project and Quizzes (10%)
	  • Group Project and Quizzes (10%)

Lectures List

Week#1
- Lec#1: **Introduction and Basic Concepts**

Week#2
- Lec#2: **BJT Review**
- Lec#3: **BJT Biasing Circuits**

Week#3
- Lec#4: **BJT Modeling and r_e Transistor Model**
- Lec#5: **Hybrid Equivalent Model**

Week#4
- Lec#6: **BJT Small-Signal Analysis**
- Lec#7: **Systems Approach**

Week#5
- Lec#8: **General Frequency Considerations**
- Lec#9: **BJT Low Frequency Response**

Week#6
- Lec#10: **BJT High Frequency Response**
- Lec#11: **Multistage Frequency Effects and Square-Wave Testing**

Lectures List..

Week#7
- Lec#12: **Power Amplifiers (Class A & B)**
- Lec#13: **Power Amplifiers (Class C & D**)

Week#8
- Lec#14: **Tuned Amplifiers (p1)**
- Lec#15: **Tuned Amplifiers (p2)**

Week#9
- Lec#16: **Oscillators (RC Circuits**)
- Lec#17: **Oscillators (LC Circuits)**

Week#10
- Lec#18: **Mixers Circuits (p1**)
- Lec#19: **Mixers Circuits (p2)**

Week#11
- Lec#20: **Modulation Circuits (p1)**
- Lec#21: **Modulation Circuits (p2l)**

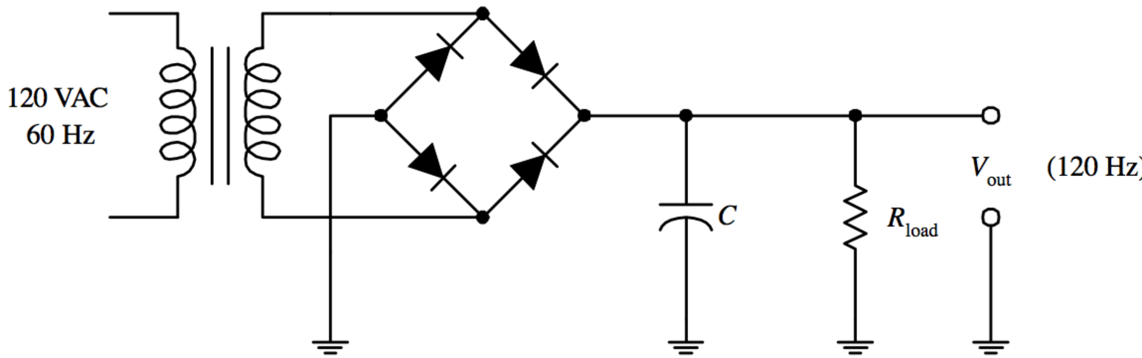
Week#12
- Lec#22: **Project Delivery and Oral Exam (Group1)**
- Lec#23: **Project Delivery and Oral Exam (Group2)**

Review

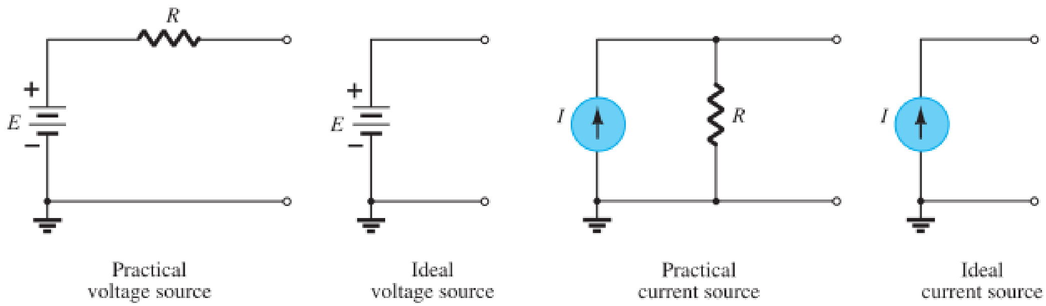
BASIC CONCEPTS

Sources

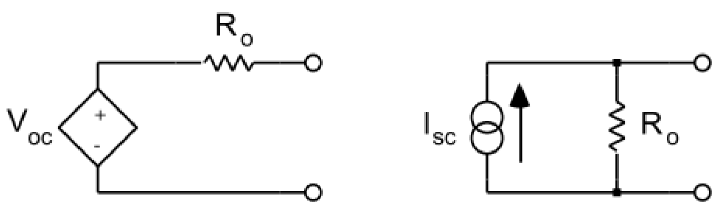
- AC/DC:



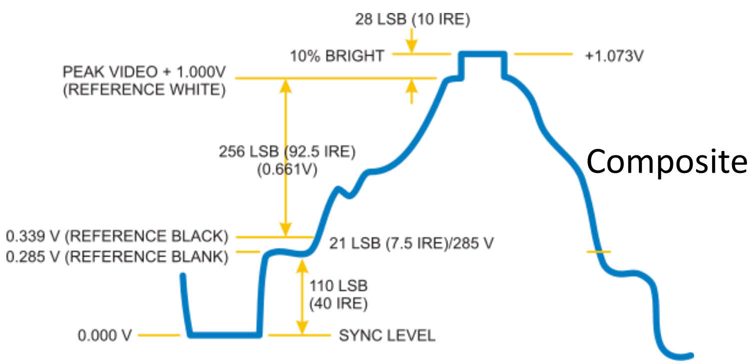
- Voltage/Current, Practical/Ideal:

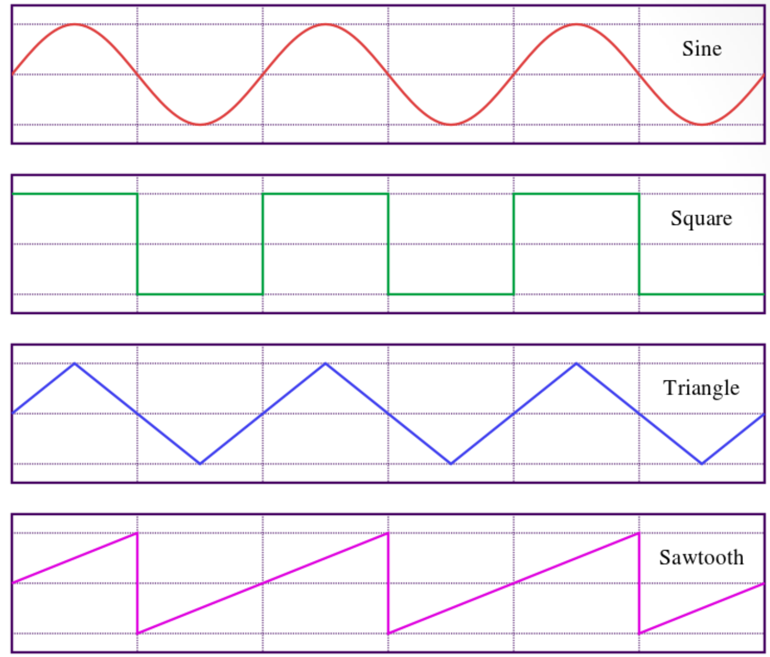


- Equivalent: Thévenin & Norton $I_{SC} = \frac{V_{OC}}{R_o}$



Signals





To compute the RMS, take the signal, square it, average it, and take the square root...

$$V_{RMS} = \sqrt{AVG\{v(t)^2\}} = \sqrt{\frac{1}{T}\int_0^T v^2(t)\,dt}$$

Some useful RMS formulas:

$$\text{Sinewave RMS} = \frac{V_{peak}}{\sqrt{2}} = \frac{V_{peak\text{-}to\text{-}peak}}{2\sqrt{2}}$$

$$\text{Symmetrical Squarewave RMS} = V_{peak} = \frac{V_{peak\text{-}to\text{-}peak}}{2}$$

$$\text{Triangle Wave RMS} = \frac{V_{peak}}{\sqrt{3}} = \frac{V_{peak\text{-}to\text{-}peak}}{2\sqrt{3}}$$

- Amplitude!
- Frequency!
- Peak Voltage!
- RMS value!

Amplifiers

- Gain!
- Input Resistance/Impedance!
- Output Resistance/Impedance!

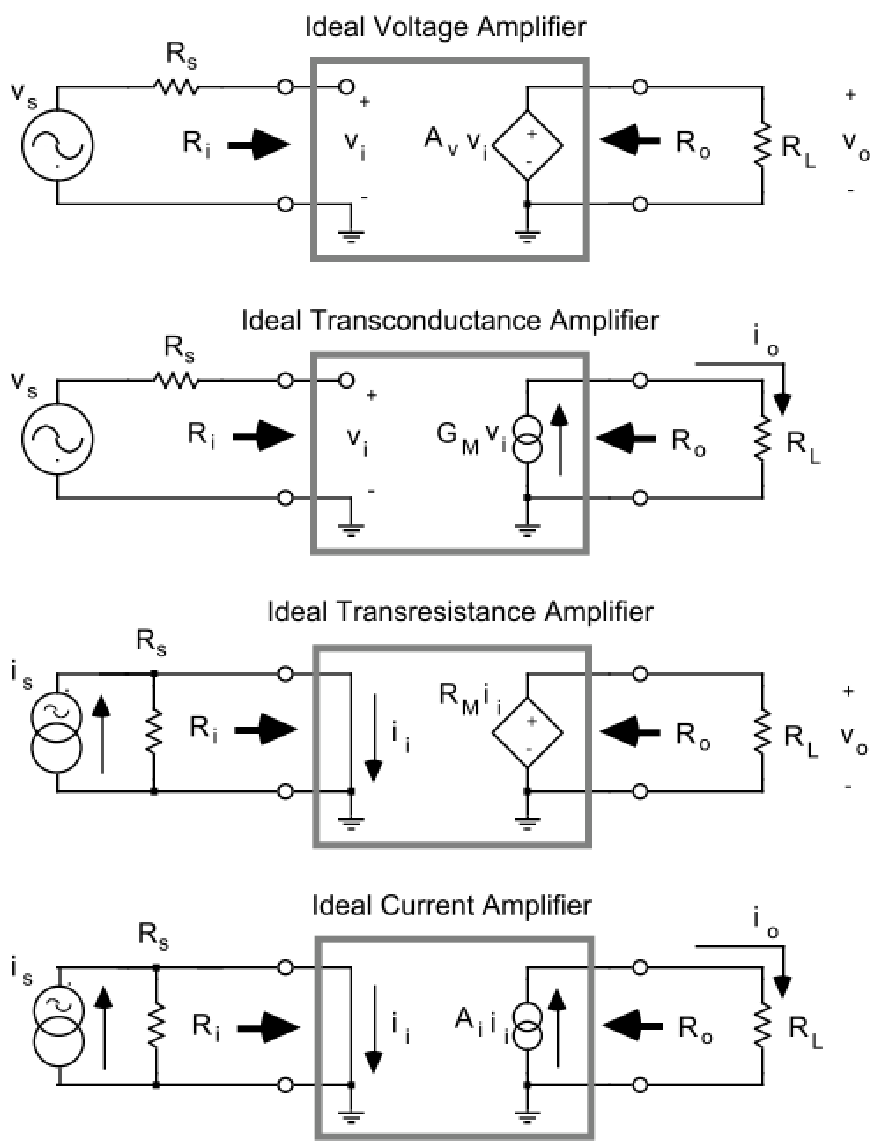
$$\text{VOLTAGE GAIN} = A_v = \frac{v_o}{v_i}$$

POWER gain

$$dB = 10\log_{10}\left(\frac{P_{out}}{P_{in}}\right) dB = 20\log_{10}(A_v)$$

$$\text{POWER GAIN} = A_p = \frac{p_o}{p_i} = \frac{i_o v_o}{i_i v_i}$$

SCHEMATICS OF THE BASIC AMPLIFIER TYPES



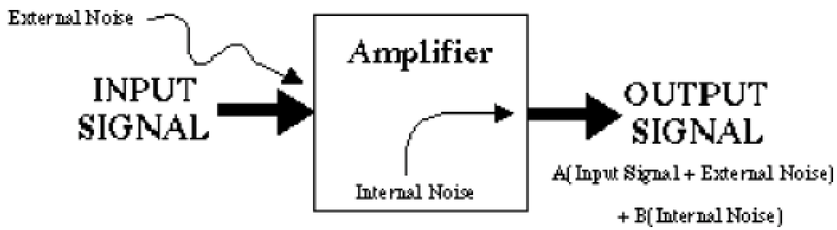
Amplifiers..

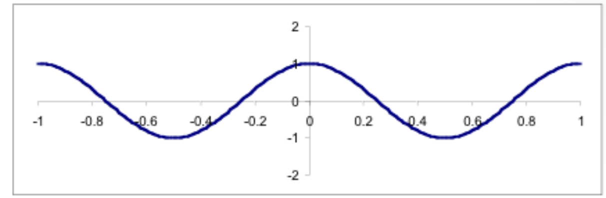
characteristics

Source Parameter to be Amplified	Desired Output Parameter	Type of Amplifier	Gain Expression	Ideal Input Impedance	Ideal Output Impedance
source voltage, v_s	v_o	Voltage	$A_v = \frac{v_o}{v_s}$ = voltage gain (dimensionless)	$Z_i = \infty$	$Z_o = 0$
source voltage, v_s	i_o	Transconductance	$G_m = \frac{i_o}{v_s}$ = transconductance in Ω^{-1} or Siemens	$Z_i = \infty$	$Z_o = \infty$
source current, i_s	v_o	Transresistance	$R_m = \frac{v_o}{i_s}$ = transresistance in Ω	$Z_i = 0$	$Z_o = 0$
source current, i_s	i_o	Current	$A_i = \frac{i_o}{i_s}$ = current gain (dimensionless)	$Z_i = 0$	$Z_o = \infty$

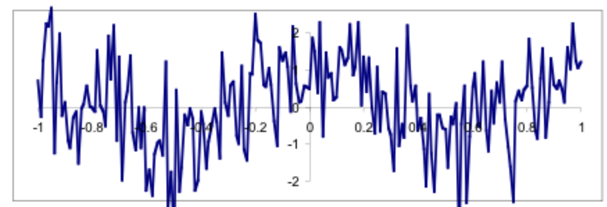
Noise & Distortion

NOISE is unwanted signal(s) that end up added to the desired signals.



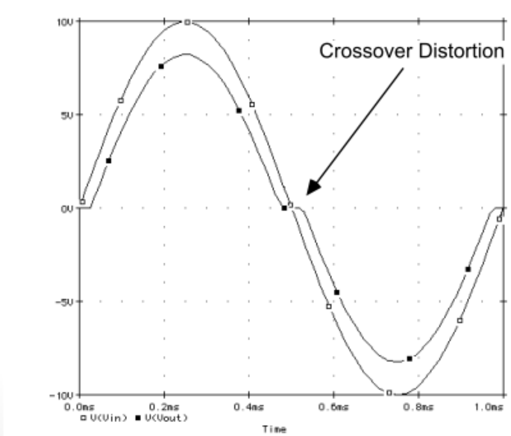


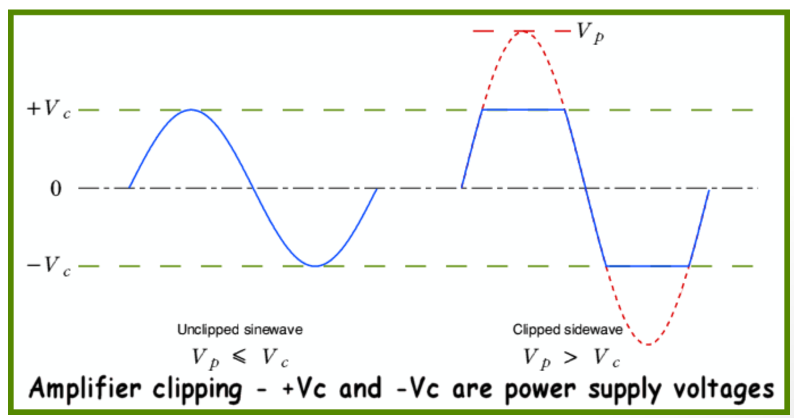
(a)



(b)

- **DISTORTION** of a signal occurs when the amplified version of the signal coming out of the amplifier is not simply a scaled copy of the input signal, but is differently shaped (distorted).

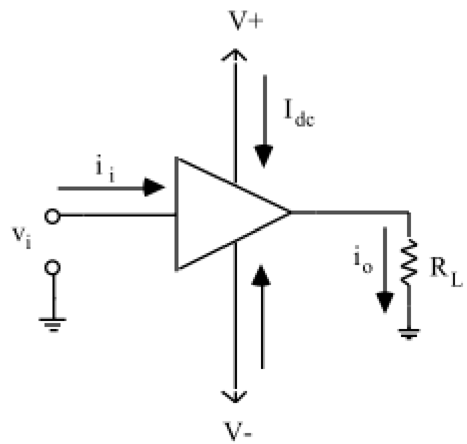




Amplifier Power Supply and Efficiency

- All amplifiers need some type of power supply to supply the extra energy that is delivered to the load.

- Most analog amplifiers use two power supply voltages or “rails,” as shown below,



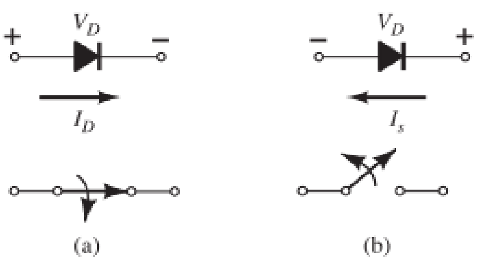
- Some amplifiers use only a single power supply voltage, but sometimes they internally "split" that single voltage into two rails by making an artificial "ground" voltage half way from "real ground" to the supply voltage.

- The efficiency of an amplifier reflects the amount of power delivered to the load as a fraction of the total power drawn from the power supply, and can be computed using:

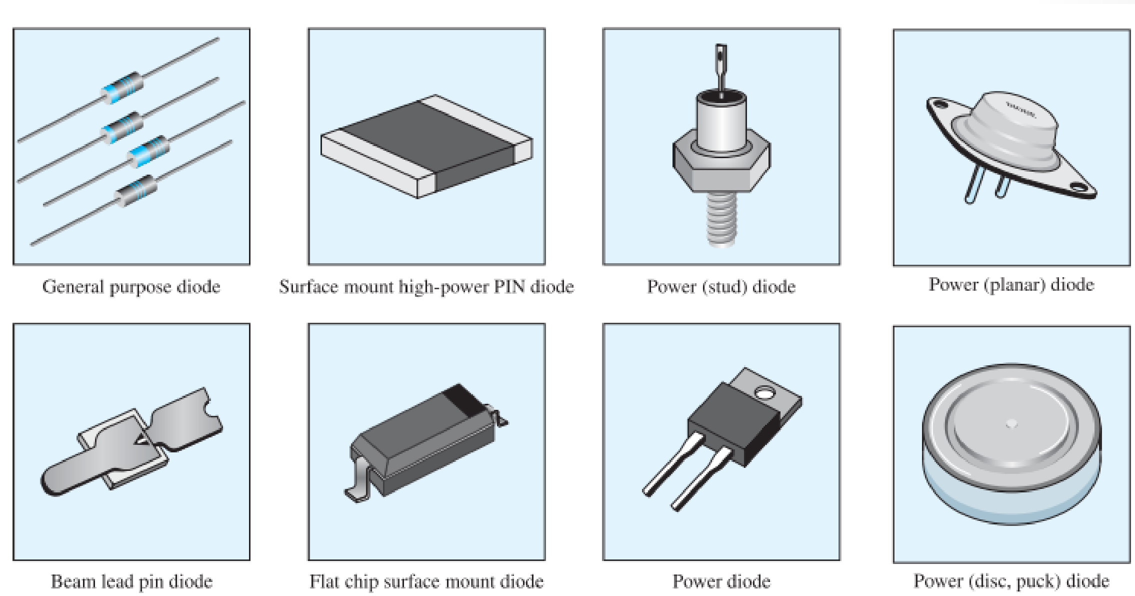
$$\eta = \frac{P_L}{P_{dc}} \times 100\% = \frac{\text{Power Delivered to Load}}{\text{Power Used from Power Supplies}} \times 100\%$$

Diodes

Ideal semiconductor diode: (a) forward-biased; (b) reverse-biased.

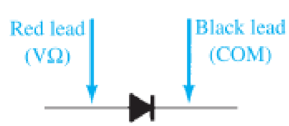


Various types of junction diodes.

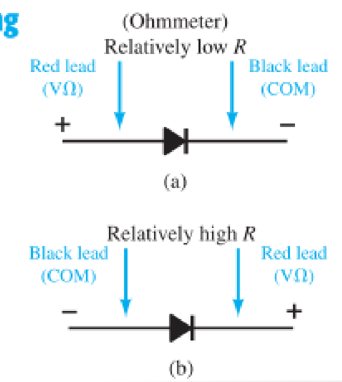


DIODE TESTING

Diode Checking Function



Ohmmeter Testing



- For more details, refer to:
  - Text books for ECE-121, ECE-222.
- The lecture is available online at:
  - https://speakerdeck.com/ahmad_elbanna
- For inquires, send to:
  - ahmad.elbanna@fes.bu.edu.eg
  - ahmad.elbanna@ejust.edu.eg