Electronic Circuits for Mechatronics (ELCT 609)

Spring 2021

Lecture 1: Course Introduction

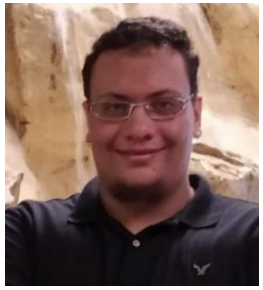
Course Instructor: Dr. Eman Azab

GUC
German University in Cairo
الجامعة الألمانية بالقاهرة

COURSE TEAM

- Course Instructor: **Dr. Eman Azab**
  - Office: C3:315, Email: eman.azab@guc.edu.eg

- Teaching Assistant: **M.Sc. Eng. Mohamed Elhadad**
  - Office: C3.2XX, Email: mohamed.elhadad@guc.edu.eg



- Teaching Assistant: **M.Sc. Eng.: Yasmine Massoud**
  - Office: C3.2XX, E-mail: **yasmin-.massoud@guc.edu.eg**

COURSE SCHEDULE & ASSESSMENT

Course Material	Source
One Lecture per Week	**Every Tuesday face-to-face & VOD**
One Tutorial Bi-weekly	**Check your Group Schedule Hybrid Tutorials face-to-face & VOD**

Evaluation Method	Grades
Assignments	10%
Quizzes	15%
Project	15%
Midterm	20%
Final	40%

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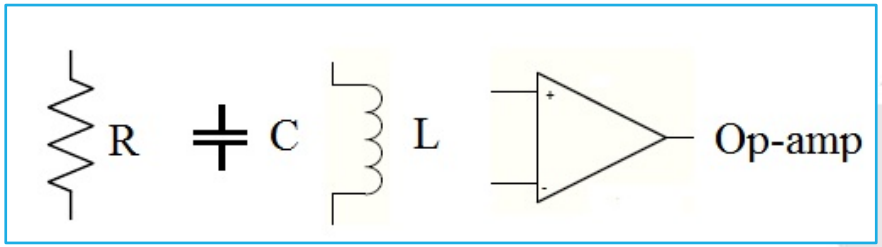
Course Guidelines & Prerequisites

- Quizzes and Assignments are best 2 out of 3
- Course Prerequisites:
  - Electric Circuits I
  - Electric Circuits II
- **What did you learn in ELCT I and II??**
  - how to build and analyze electric circuits
  - I-V characteristics of Passive and Active Elements



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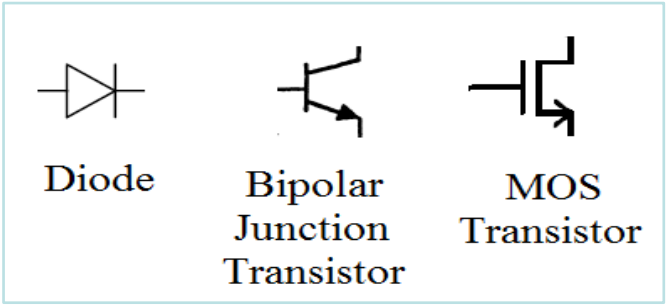
Course Objectives

- Introduce Electronic circuit components, such as:
  - Diodes
  - Transistors



- Learn their Physical structure and I-V characteristics
- Electronic Circuits Analysis
- How to build Electronic Circuits?
- Electronic Circuits applications

Tentative Course Schedule

Week	Lecture	Description
1	**Introduction & P-N Junctions (Diodes)**	Course Overview and Diodes physical structure (Electrically Controlled Switch)
2 &3	**P-N Junctions (Diodes): Circuit Analysis and Applications**	Diodes I-V characteristics and applications (switches, rectifiers, voltage limiters etc.)
4	**Bipolar Junction Transistor: Physical Structure and I-V Characteristics**	Transistor Physical Structure and its circuit analysis while using DC sources (Attention: related to Diodes)
5	**Bipolar Junction Transistor Application: Analog Amplifiers**	Amplifiers Circuit Analysis (How the transistor behaves when additional AC sources are used?) Ex.: Microphone
6	**MOS-FET Transistor: Physical Structure and I-V Characteristics**	Transistor Physical Structure and its circuit analysis while using DC sources (Attention: Similar to Bipolar Transistor)
	Mid-term Exam	**All topics up to week 6 will be included**
7	**MOS-FET Transistor Application: Analog Amplifiers**	Amplifiers Circuit Analysis (How the MOS-FET transistor behaves when additional AC sources are used?)
8 & 9	**Frequency Response of Amplifiers**	Amplifiers response to different input signal frequencies
10 &11	**Differential Amplifiers and Current Sources**	Differential input/output Amplifiers, (How can we design a constant Current Source using Transistors?)
12	**Analog Signal Processing Applications**	Amplifiers, Adder, Multiplier…etc.
	Final Exam	**All topics will be included**

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Tentative Course Evaluation Schedule

Week	Assignment	Quiz	Project
4		Quiz 1: Diodes	
5	Assignment 1: Bipolar Junction Transistor Amplifiers Analysis		
8		Quiz 2: MOS-FET DC and AC Analysis	Practical Project (in Addition to Theoretical and Simulation Analysis are included)
9	Assignment 2: Frequency Response of Amplifiers		
11		Quiz 3: Differential Amplifier	
12	Assignment 3: Analog Signal Processing Applications		

References

1. "**Electronic Principles**", Malvino & Bates
2. "**Microelectronics Circuits**" , Sedra & Smith
3. "**Electronic Devices and Circuits**", Bogart, Beasley & Rico
4. "**Microelectronic Circuits Analysis and Design**", Rashid
5. "**Analysis and Design of Analog Integrated Circuits**", Gray, Hurst, Lewis & Meyer
6. "**Fundamentals of Microelectronics**", Razavi
7. "**Analog Integrated Circuit Design**", Johns & Martin

Electronic Circuits

Introduction

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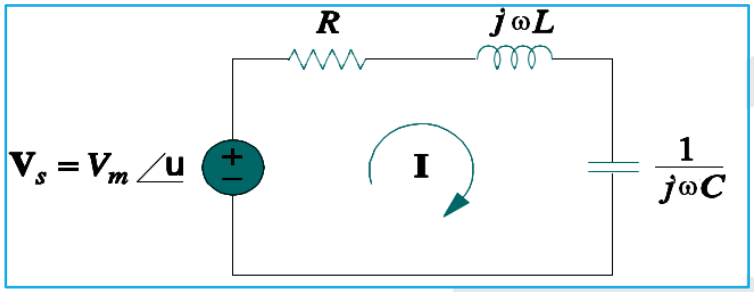
Definition

- **What is meant by Electric Circuit?**
  - A closed path in which current flows in conducting material
  - Current flows in presence of a Voltage/Current source.
  - Contains discrete components like R,L & C
  - Elements of electric circuits are connected through wires

Current flows through a conducting material

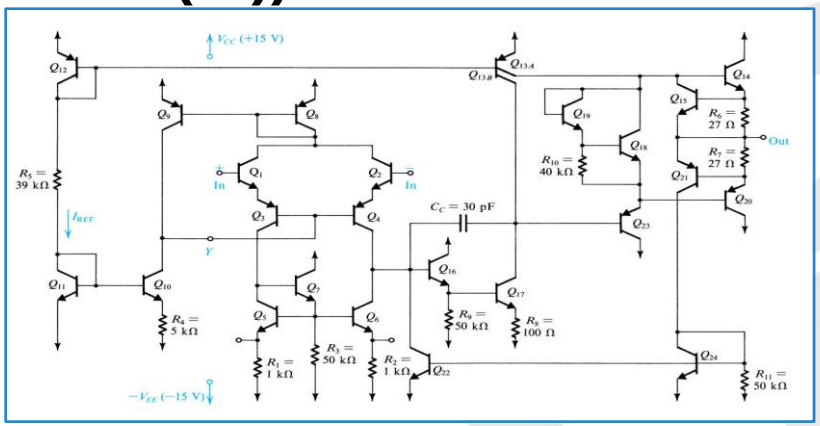


Prof. Dr. Yasser Hegazy Lectures (ELCT II)

Definition

- **What is meant by Electronic Circuit?**
  - A closed path in which current flows as charges in **gas, vacuum or semiconductor material**
  - Current flows in presence of a Voltage/Current source
  - Contains components like **Diodes, Transistors** etc.
  - **Circuit Components can be integrated on a small-sized chip (Integrated Circuit (IC))**

Current flows through a Semiconducting material



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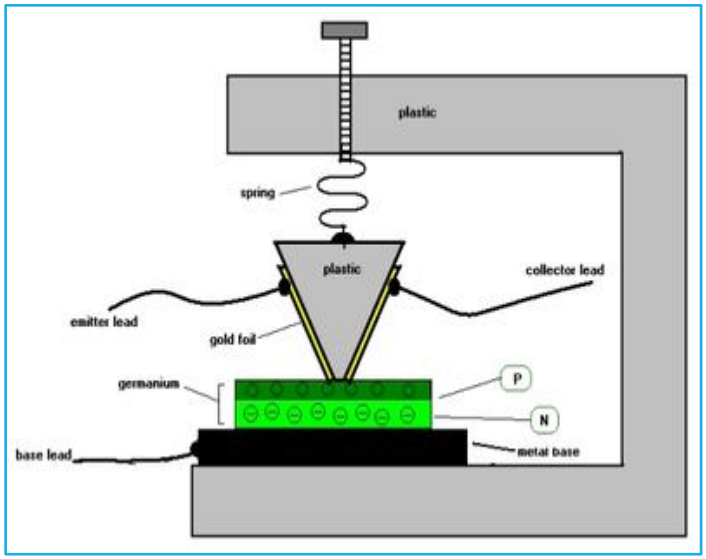
History and Present

- First Transistor 1947
- Bell Labs, Point Contact Transistor



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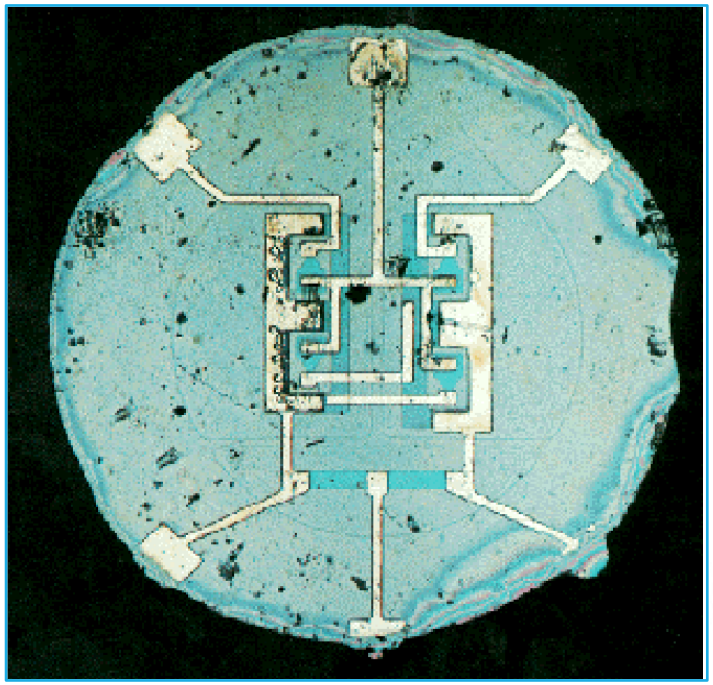
History and Present

- Discrete Transistors

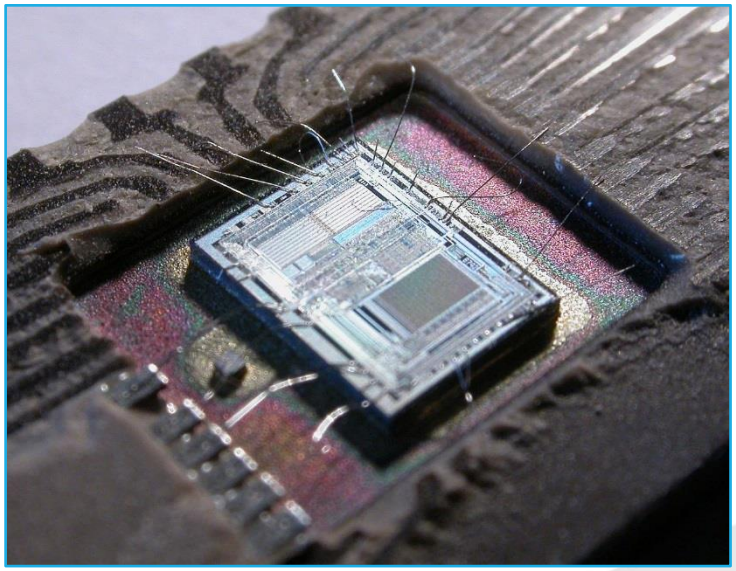
History and Present

- First Silicon planar IC chip
- Made by R. Noyce of Fairchild Camera in **1961**
- A flip-flop circuit containing **Six** devices



History and Present

- Intel 8742 Die
- 8-bit Microcontroller
- CPU at 12 MHz
- 128 bytes of RAM
- 2048 bytes of EPROM
- I/O Pins
- **Source:** Intel Corporation

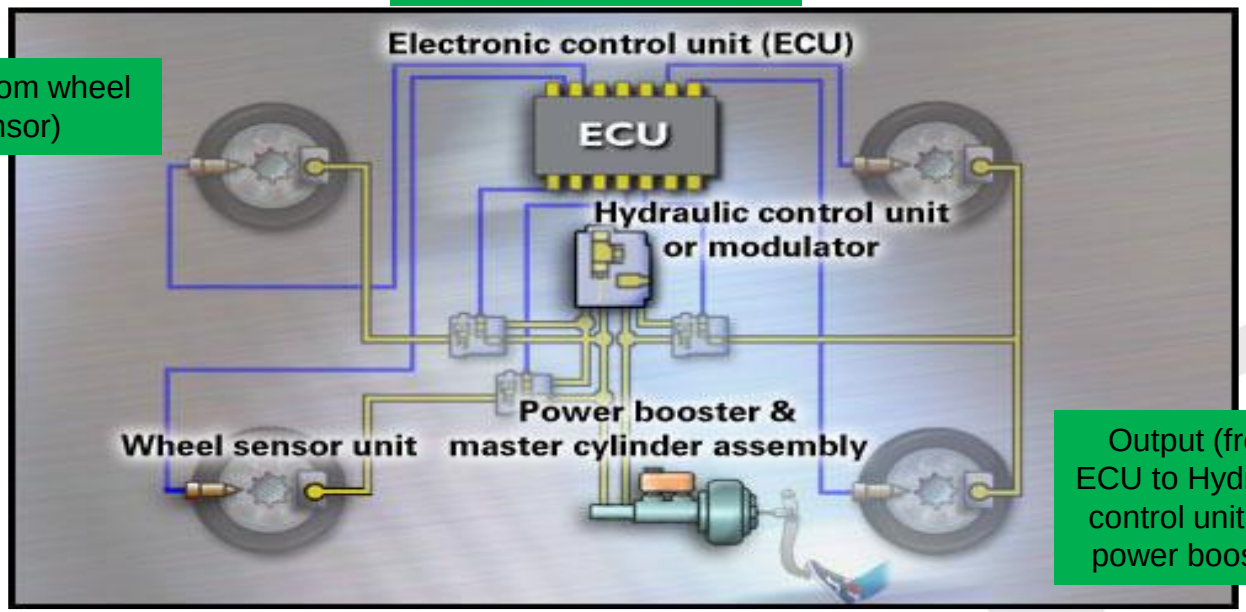


Electronic Systems

- **Why we need Electronic Circuits?**
  - For any Information Signal processing Application, Ex. Cars Electronic ABS System

Information processing (by Electronic control unit)

Input (from wheel sensor)



Output (from ECU to Hydraulic control unit and power booster)

Source: http://www.cdxetextbook.com/brakes/brake/abs/abscomponents.html