

CLASS 2:
OVERVIEW OF ELECTRICAL
ENGINEERING

ENGR 102 – Introduction to Engineering

2

Electrical Engineering

Electrical Engineering in ENGR 102

3

- ENGR 102 provides a brief intro to ***electrical engineering***
 - Circuit fundamentals
 - Microcontrollers
 - Solar panels
 - Batteries
 - Motors/generators
 - Programming

- ***What is electrical engineering?***
 - What to electrical engineers do?

What is Electrical Engineering?

4

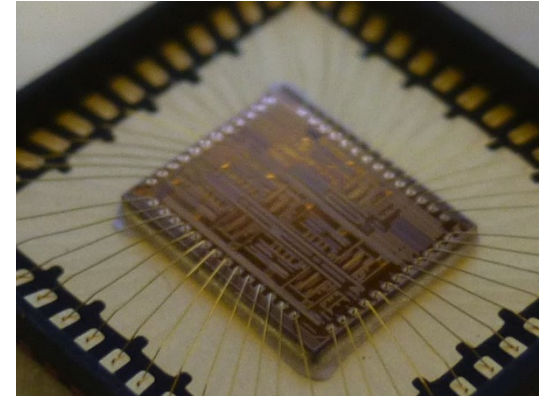
- Many categories of electrical engineers
- Most fall into one of two areas:

- **Electronics**

- Consumer electronics
- Embedded systems/IoT
- Electronic test/measurement
- Computer engineering
- Controls/robotics
- Energy systems

- **Power systems**

- Power generation, transmission, distribution, storage
- Electric drives
- Building systems
- Controls/robotics
- Energy systems



source: Magnus Manske

Electrical Engineering

5

- Consider an ***electric vehicle***
 - ▣ Where might ***electronics*** and ***power system*** engineers contribute



Vehicle subsystem	Electronics	Power systems
Motors		X
Battery management system	X	X
Inverters/electric drives		X
Traction control/torque vectoring	X	X
Regenerative braking	X	X
Autopilot	X	
Entertainment/navigation/ Instrumentation	X	

6

Electricity

Electricity – what is it?

7

- Fundamental form of ***energy***
 - Has the potential to perform ***work***
 - Resulting from ***charge differentials***

- Charge differentials store ***electrical energy***
 - Analogous to a stretched spring, pressurized vessel, elevated mass, ...

- Where does electrical energy come from?
 - May occur naturally
 - Lightning, static electricity
 - May be produced by conversion from other forms of energy
 - Generator, battery, solar panel

Electricity – why do we care?

8

- Electricity can do ***work*** for us
 - ▣ Mechanical, heat, light, etc.
- Efficient means of ***energy transmission***
 - ▣ Large regions supplied by a single power plant
- Used to process, transmit and, store ***information***
 - ▣ Computers
 - ▣ Embedded systems
 - ▣ Communications – wired and wireless
 - ▣ Instrumentation and measurement

Relevance for *ALL* Engineers

9

- Very few engineered systems without electronics
 - Aircraft, automobiles, appliances, robotics, etc.

- ***Energy***
 - Efficient means of transmission & distribution
 - Efficient conversion
 - Motors/generators

- ***Instrumentation and measurement***
 - All engineered products and systems must be tested, measured, and evaluated
 - Electronic measurements are fast, accurate, repeatable, and can be automated

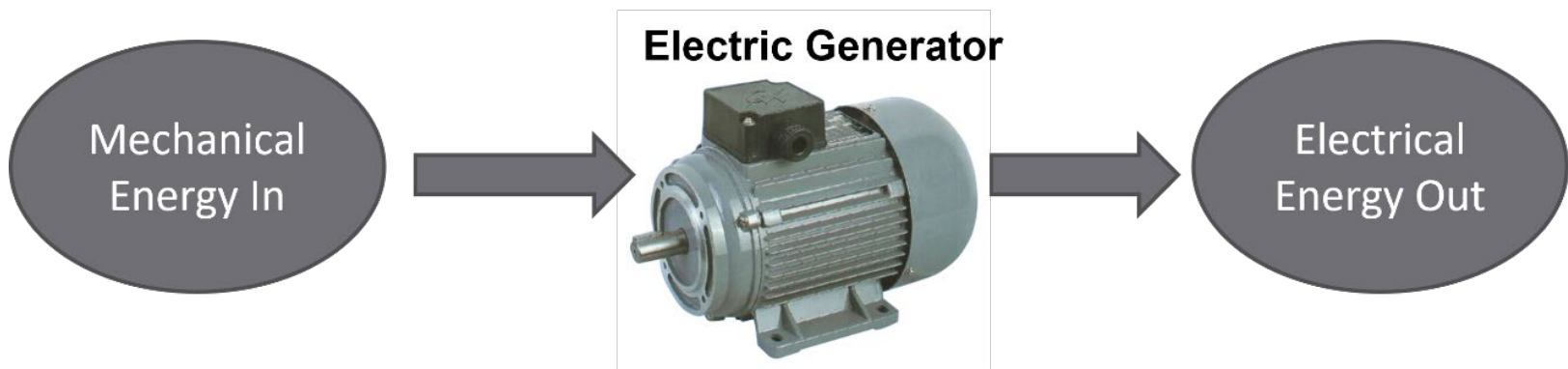
10

Electrical Energy

Electrical Energy

11

- Energy is conserved, but may be converted from one form to another
- Electrical energy – charge differentials – produced from other forms of energy
 - ▣ Generator: mechanical energy → electrical energy
 - ▣ Battery: chemical energy → electrical energy

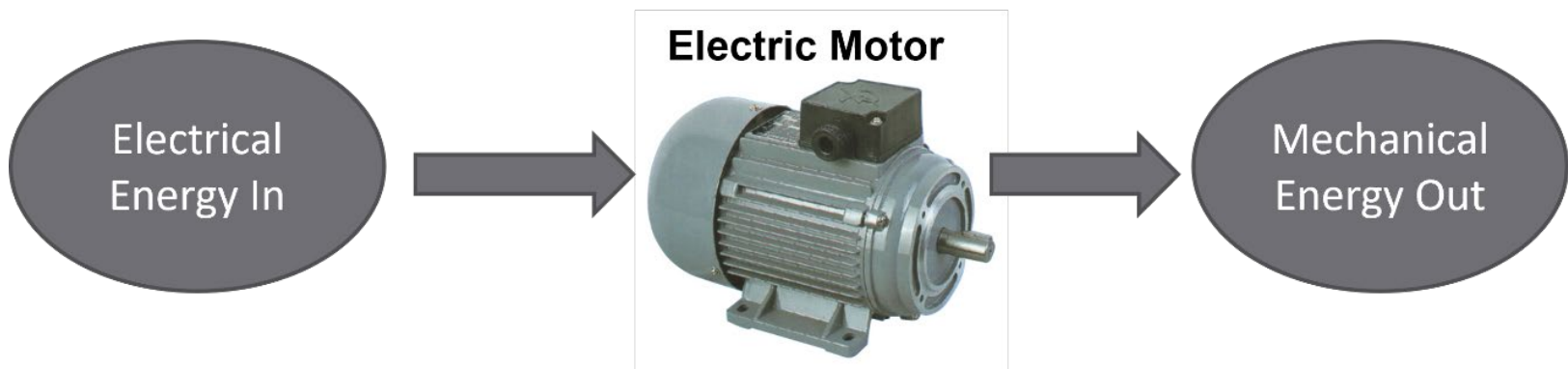


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Electrical Energy

12

- Electrical energy can be converted into other useful forms of energy
 - ▣ Motor – mechanical energy
 - ▣ Heater – thermal energy
 - ▣ Charged battery – chemical energy



<http://www.trimainternational.com/Products/de.htm>

Energy Transmission

13

- Electricity is an efficient means of ***energy transmission***
 - ▣ Energy is transmitted broadly from a single power plant
 - ▣ No longer need to grind our wheat at the windmill

- Imagine other modes of energy transmission
 - ▣ Hydraulic, pneumatic, cables, rotating shafts
 - ▣ Pneumatic was used in some European cities and was proposed for transmission of energy from Niagara to Buffalo in late 19th century

14

Electricity and Information

Electricity and Information

15

- In addition to doing work and transmitting large quantities of power, electrical energy can be used to ***process, transmit, and store information***
 - Computing
 - Desktops, laptops, tablets, phones
 - Data centers, cloud computing
 - Communications
 - Cell phones
 - Internet, LAN, WiFi
 - Radio
 - Data storage
 - RAM, flash
 - Data centers, cloud storage

Instrumentation and Measurement

16

- Engineers apply data processing, transmission, and storage to ***instrumentation and measurement***
 - ▣ Sensors
 - E.g., temperature, pressure, current, strain, flow, torque...
 - ▣ Measurement devices
 - E.g., multimeters, oscilloscopes, data-acquisition systems...
 - ▣ Measurement data processing and analysis
 - E.g., MATLAB, Python, LabView...

- Skills required:
 - ▣ Circuit fundamentals
 - ▣ Familiarity with lab equipment
 - ▣ Programming