BME322 – Design VI

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Course Schedule – Fall 2009

Class #	BME-322A (Wed)
Class 1	September 2
Class 2	September 9
Class 3	September 16
Class 4: Course projects	September 23
Class 5	September 30
Class 6: Writing workshop	October 7
Class 7	October 14
Class 8	October 21
Class 9	October 28
Class 10	November 4
Class 11 : Presentation workshop	November 11
Class 12	November 18
Class 13	December 2
Class 14: Final presentations	December 9

Project Groups

BME322 – Design VI

Class 1

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Course Introduction

- Course logistics
- Reference material
- Course requirements & Grading policy
- Course topics

Course Logistics

- This will be a team-based course, preparing you for Senior Design
- You will be introduced to two important (EE) technologies for biomedical systems:
  - Wireless technology
  - Signal processing technology
- The course material will consist of lectures, lab experiments, and computer simulation tools (Matlab/Simulink)
- You will also be expected to use the Stevens library to research material for your project and general class discussions (generally the IEEE database, Iexplore)
- Your primary deliverable for the course will be a project report and presentation due at the end of the course
- We will meet every week

Reference Materials

- Relevant articles from IEEE Transactions on Biomedical Engineering and other relevant sources will be posted on the course web site (elearn.stevens.edu)

- Matlab/Simulink simulation tools will be posted on the course web site for you to experiment with

Course Requirements

- Each student will be expected to participate in class discussions on relevant topics to the lectures/experiments. Lack of attendance and/or lack of participation are likely to lead to formal assignments to present selected research papers
- Each student will join a design group consisting of approximately 4 members. Teams are to be formed by Class 2
- Groups members will jointly develop a proposal for a biomedical project, preferably utilizing the technologies discussed this semester (i.e., wireless and signal processing technologies). The initial project idea will be due by Class 4
- A brief (~7 page) midterm report, outlining the general topics to be researched will turned in by Class 7
- A complete project report will be turned in by Class 13
- A Powerpoint presentation on the project will be delivered to BME and other faculty during Class 14

Grading

- Participation 10%
- Midterm report 25%
- Final report 50%
- Final presentation 15%

- Although nearly all the graded work in the course is group based, the Stevens Honor System still applies. In particular, plagiarism or failure to fully cite all sources will not be tolerated.

- All written reports and presentations must be submitted electronically to my email address (bmcnair@stevens.edu) or via the elearn email system.

- For me to keep submissions straight from this and other courses I am teaching, all email attachments must be labeled as:

  BME322 – Group – assignment_name

  e.g., “BME322 – Improved MRI – midterm report.doc”

Course Topics

- Electronics review
  - Electromagnetic properties
  - Electromagnetic fields
  - Electromagnetic effects
  - Analog and digital signals
  - A/D conversion
  - D/A conversion
  - Filtering
  - Frequency vs. time domain
- Modulation and demodulation
  - Analog and digital
- Wireless systems
  - Bandwidth
  - Multiplexing
  - Spectrum
- Noise and grounding
- Media, Antennas and propagation
- Interaction between electronic systems and biological systems
- Signal processing
  - Averaging, filtering
  - Measuring periodicity (correlation)
  - Spectral analysis
  - Detection of signals in noise

TOPIC 2 – INTRO TO ELECTROMAGNETICS

2.1 Basic Electronics

2.1.1 V, I, R and Ohm's Law

Basic electrical parameters

- Voltage – the electrical "push" – in units of Volts (V)
- Current – the electrical "flow" – in units of Amperes (A)
- Resistance - the electrical "obstruction" – in units of Ohms

Ohm's Law – applies to all circuits both AC and DC

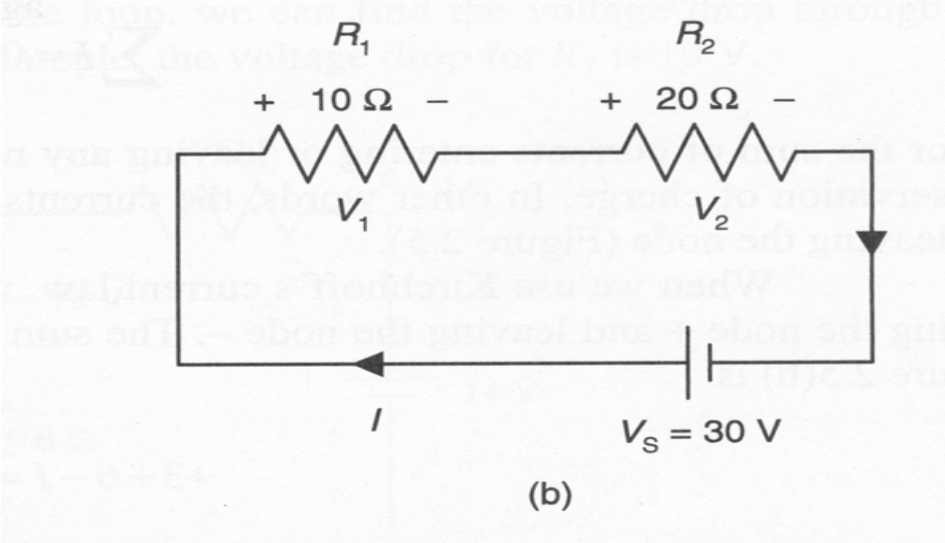
- $V = I * R$

Note: Most of these class slides are based on materials developed by Al Messano and other authors in previous sessions of BME322. Such material remains the property those authors. The slides are used with their permission.

TOPIC 2 – INTRO TO ELECTROMAGNETICS

2.1 Basic Electronics

2.1.1. V, I, R and Ohm's Law



TOPIC 2 – INTRO TO ELECTROMAGNETICS

2.1 Basic Electronics

2.1.2. Capacitance (C)

- Electric component which generates a Current which is proportional to the change in voltage across it:

  $I(t) = C(dV/dt)$

- Basic unit: Farad (F).
- Acts like a battery that wants to charge up.
- Consists of two parallel plates of surface area A separated by a distance d.
- The Capacitance is given by:

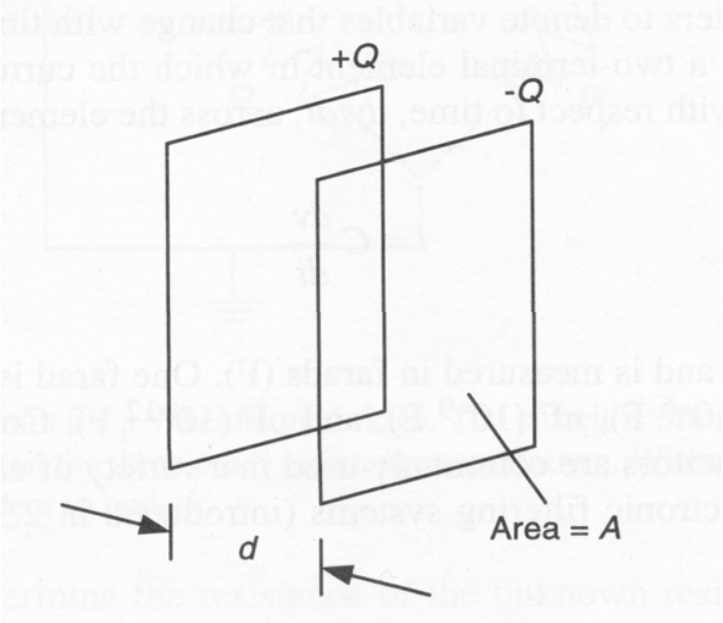
  $C = (\varepsilon * A)/d$

  Where ε is the electric Permitivity of the dielectric

TOPIC 2 – INTRO TO ELECTROMAGNETICS

2.1 Basic Electronics

2.1.2. Capacitance (C)



TOPIC 2 – INTRO TO ELECTROMAGNETICS

2.1 Basic Electronics

2.1.3. Inductance (L)

- Electric component which generates a Voltage which is proportional to the change in Current across it:

  $v(t) = L(dI/dt)$

- Basic unit: Henry (H).
- Consists of a coil of conductive material.
- Calculation of Inductance is complex being based on the geometry of the coil and the magnetic permeability (u) of the material used.

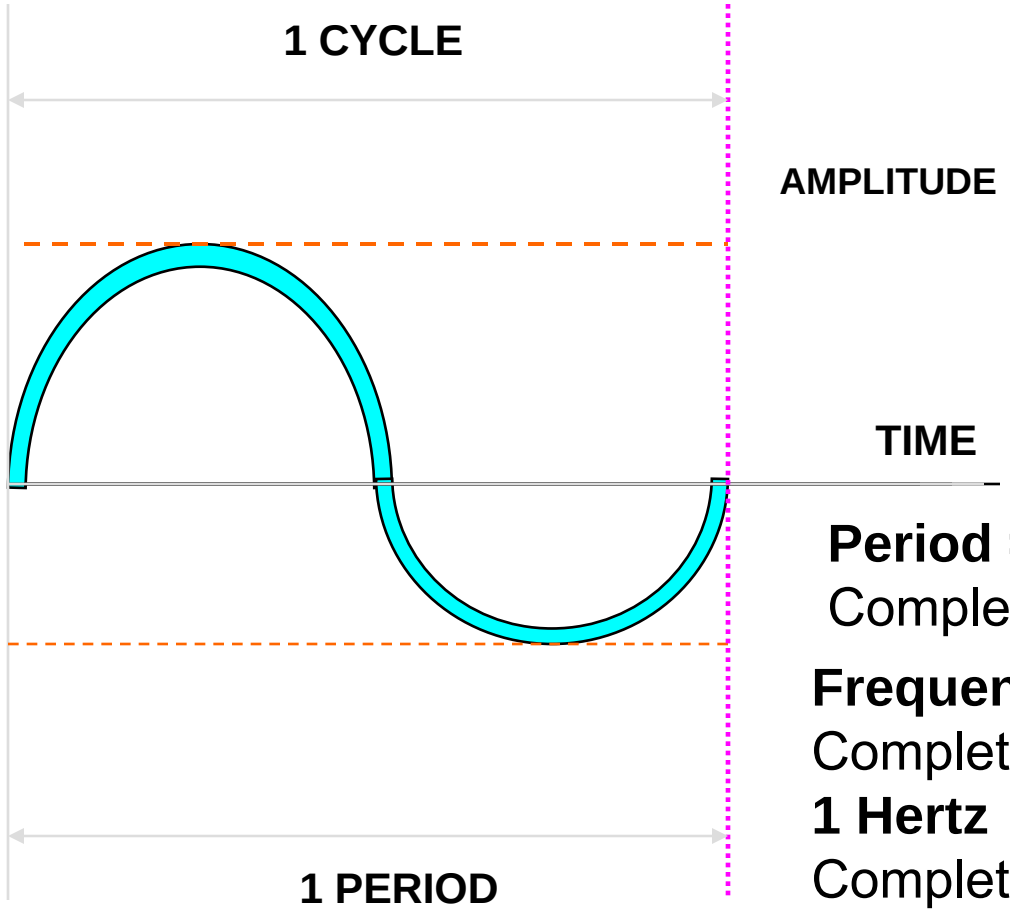
2.1. Basic Electronics

2.1.4. Frequency

Essential Characteristics For All Types of Waves

- Amplitude
- Frequency
- Wavelength

2.1. Basic Electronics

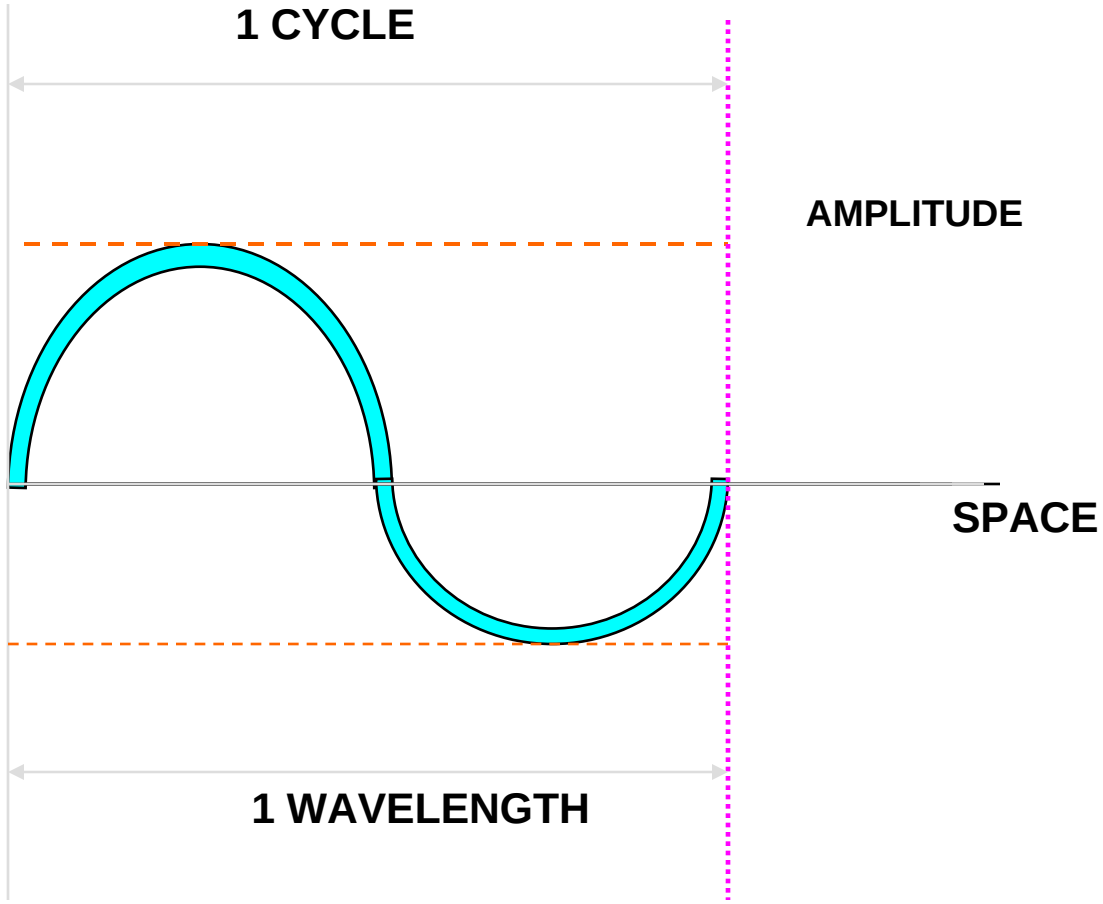


Period = time to Complete 1 **Cycle**

Frequency = # of Cycles Completed per second

1 Hertz = 1 Cycle Completed per second

2.1. Basic Electronics



2.1. Basic Electronics

Frequency and Wavelength

- Frequency is measured in Hertz or Cycles per Second.
- Wavelength is measured in units of length.
- The higher the frequency, the shorter the wavelength.
- The higher the frequency, the higher the energy content.

TOPIC 2 – INTRO TO ELECTROMAGNETICS

2.1. Basic Electronics

- 2.1.5 Impedance
- Electrical components have responses that vary with frequency.
- This frequency response is known as impedance, Z.
- Impedance has both a real and a complex part and is of the form: Z = R + jX where X is called Reactance.
- So the following relationships hold:
  - Resistor: $Z = R + 0*j = R$
  - Capacitor: $Z = 0 - j/\omega C = -j/\omega C$
  - Inductor: $Z = 0 + j\omega L = j\omega L$
    - Where ω = radial frequency = $2 * \pi *$ frequency [Hz]

TOPIC 2 – INTRO TO ELECTROMAGNETICS

2.1. Basic Electronics

Impedance and Capacitance Effects

TOPIC 2 – INTRO TO ELECTROMAGNETICS

2.1. Basic Electronics

2.1.6. Typical Electrical Responses