GS02 1202: Electronics for Medical Physics
Fall 2020 Schedules

Day: Tuesdays/Thursdays, September 1 – December 15, 2020

Time: 9:00am – 10:00am

Location: Online Virtual Zoom or FCT14.5059 (Imaging Physics Classroom)

Contact: Xinming Liu, Ph.D. – course coordinator
FCT14.6094, 713-745-2834 (office), 832-794-3576 (cell) xliu@mdanderson.org
Admin Assistant: Margaret Copeland
FCT14.6072, 713-792-8093, MRCopeland@mdanderson.org

Instructors: Jim Bankson, Ph.D. – 3SCR2.3608, 713-792-4273 (office)
Richard Bouchard, Ph.D – 3SCR2.3614, 713-745-0626 (office)
Xinming Liu, Ph.D. – FCT14.6094, 713-745-2834 (office)
Ramesh Tailor, Ph.D. – FCT8.6068, 713-563-2638 (office)

Course Credit: 2 semester hours

Contact Hours: 24 lecture hours plus three 2-3 hour labs


Additional References: The Art of Electronics, Paul Horowitz and Winfield Hill, Cambridge
Basic Electronics for Scientists, James Brophy, McGraw-Hill
The Essential Physics of Medical Imaging (Bushberg) Chapter 12: Ultrasound

Grading Policy:

15% Exam 1
15% Exam 2
20% Labs
25% Homework/Quiz/Participation
25% Final
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| 9/1    | 1       | Course Introduction & Overview  | DC voltage, current, and power; resistors; Kirchoff’s laws;  
Reading: Hambley,  
Chapter 1: Introduction                                              | Bankson      |
| 9/3    | 2       | DC Circuit Analysis I           | Current divider; voltage divider; node analysis; mesh analysis  
Reading: Hambley,  
Chapter 2: Resistive Circuits                                                 | Bankson      |
| 9/8    | 3       | DC Circuit Analysis II          | Equivalent circuits; maximum power transfer (impedance matching); superposition           | Bankson      |
| 9/10   | 4       | DC Circuit Analysis, Cont’d     |                                                                                           | Bankson      |
| 9/15   | 5       | Reactive Elements               | Inductors; capacitors; first-order transient response  
Reading: Hambley,  
Chapter 3: Inductance & Capacitance  
Chapter 4: Transients                                                        | Bankson      |
| 9/17   | 6       | Reactive Elements, Cont’d       |                                                                                           | Bankson      |
| 9/22   | 7       | AC Circuits and Analysis        | Phasor notation; complex impedance; AC power; intro to AC analysis  
Reading: Hambley,  
Chapter 5: Steady-State Sinusoidal Analysis                                    | Bankson      |
| 9/24   | 8       | AC Circuits and Applications    | Frequency response; filters; Bode plots; resonance; quality factor (Q)  
Reading: Hambley,  
Chapter 6: Frequency Response...Resonance                                           | Bankson      |
| 9/29   | 9       | AC Circuits, Cont’d             |                                                                                           | Bankson      |
| 10/1   | Lab 1   | Lab Equipment & Safety; Resonance| Brief lecture, then a handful of laboratory exercises:  
Equivalent circuits and resonance                                               | Bankson      |
| 10/6   | 10      | Transformers                    | Ideal and polyphase transformers; application to x-ray systems  
Reading: Hambley,  
Chapter 15: Magnetic Circuits, Transformers                                        | Bankson      |
| 10/8   | Exam 1  | AC/DC Circuits and Analysis     | Virtual timed Zoom                                                                            | Bankson      |
| 10/13  | 11      | Introduction to Diodes          | Intro to semiconductors & the PN junction; rectification; DC power supply  
Reading: Hambley,  
Chapter 10: Diodes                                                              | Liu          |
| 10/15  | 12      | Diode Circuits                  | Zener diodes and voltage regulation; clippers, clamps, and limiters                      | Liu          |
| 10/20  | 13      | Amplifiers & Op-Amps            | Basic principles ; the operational amplifier & op-amp circuits; feedback  
Reading: Hambley,  
Chapter 11: Amplifiers : Specs & Characterist’s  
Chapter 14: Operational Amplifiers                                            | Liu          |
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<td>10/27</td>
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<td>Lab 2</td>
<td>Rectification, Operational Amplifiers</td>
<td>Liu</td>
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| 10/29      | Thurs| 15    | Overview of Bipolar Junction Transistors (BJT) and Field Effect Transistors (FET)  
Reading: Hambley,  
Chapter 12: Field-Effect Transistors  
Chapter 13: Bipolar Junction Transistors | Liu         |
| 11/3       | Tues | 16    | Transistors, Cont’d                                                 | Liu         |
| 11/5       | Thurs| 17    | Introduction to Digital Electronics, Part I  
Reading: Hambley,  
Chapter 7: Logic Circuits | Liu         |
| 11/10      | Tues | 18    | Introduction to Digital Electronics, Part II  
Reading: Hambley,  
Chapter 8: Microcomputers | Liu         |
| 11/12      | Thurs| Exam 2| Diodes & Rectification, Amplifiers, and Transistors                  | Liu         |
| 11/17      | Tues | 19    | Analog & Digital Signals  
Reading: Hambley,  
Chapter 9: Computer-based Instrum’n Systems | Liu         |
| 11/19      | Thurs| 20    | Transducers; Noise and Interference  
Reading: Horowitz & Hill,  
Chapter 7.18: Noise measurements/sources  
To Chapter 7.25: Interference, shielding, grnd’g | Liu         |
| 11/24      | Tues | 21    | RF Basics  
Transmission lines; reflection; impedance matching; Smith chart | Liu         |
| 11/26      | Thurs|      | Thanksgiving Holiday  
No class | |
| 12/1       | Tues | Lab 3 | RF Properties of Nuclear Imaging Systems  
Laboratory Exercises | Tailor      |
| 12/3       | Thurs| 22    | Applications: Electronics of Ultrasound  
Reading: The Essential Physics of Medical Imaging (Bushberg)  
Chapter 12: Ultrasound | Bouchard    |
| 12/8       | Tues | 23    | Applications: Electronics of MRI | Bankson     |
| 12/10      | Thurs|      | No class | |
| 12/15      | Tues | 24    | Review | Bankson & Liu |
| 12/17      | Thurs| Final Exam | 9am-Noon  
virtual timed Zoom, or in classroom (FCT14.5059) | Liu         |