

FLORIDA STATE COLLEGE AT JACKSONVILLE

COLLEGE CREDIT COURSE OUTLINE

COURSE NUMBER: EST 2436

COURSE TITLE: Biomedical Instrumentation I

PREREQUISITE(S): CET 1114, EET 2147 and EST 1412

COREQUISITE(S): None

CREDIT HOURS: 3

CONTACT HOURS/WEEK: 4

CONTACT HOUR BREAKDOWN:

Lecture/Discussion: 2

Laboratory: 2

Other _____:

FACULTY WORKLOAD POINTS: 3

STANDARDIZED CLASS SIZE ALLOCATION: 12

CATALOG COURSE DESCRIPTION: This course introduces students to the biomedical equipment used in patient vital signs measurement and monitoring, respiratory system measurement and monitoring, and the clinical environment in which devices are used. Students will learn external operating characteristics of devices as well as internal circuitry. Students will utilize these concepts in verifying device performance, in performing necessary calibration, and in learning preventive and corrective maintenance techniques.

SUGGESTED TEXT(S): Carr and Brown, Introduction to Biomedical Equipment Technology. New York, 1981.

Wiley, J.G. Medical Instrumentation. Houghton Mifflin, 1978.

IMPLEMENTATION DATE: Fall Term, 1990 (911)

REVIEW OR MODIFICATION DATE: Fall Term, 1994 (951)
Fall Term, 2002 (20031)

COURSE TOPICS	<u>CONTACT HOURS PER TOPIC</u>
I. Introduction to Biomedical Instrumentation	4
A. Basic Concepts of Instrumentation	
1. Classification	
2. Static and Dynamic Operating Characteristics	
3. Design Criteria	
B. Human Body Overview	
1. Anatomical Systems: Body fluids, Musculoskeletal System, Respiratory System, Gastrointestinal System, Nervous System, Endocrine System, Circulatory System	
2. Body as a Control System	
II. Electrical Safety in the Medical Environment	4
A. Physiological Effects of Electricity	
B. Important Susceptibility Parameters	
C. Distribution of Electric Power	
D. Macroshock Hazards	
E. Microshock Hazards	
F. Electrical Safety Standards	
G. Basic Approaches to Shock Protection	
H. Protection: Power Distribution	
I. Protection: Equipment Design	
J. Testing the Electrical System	
K. Electrical- Appliance Tests	
III. Biomedical Recording Systems	4
A. Physiological Systems of the Body and Origins of Bioelectrical Signals	
B. Signal Pickup Devices (Electrodes, Transducers)	
C. Signal Conditioning Devices (Filters, Amplifiers)	
D. Display Devices (CRT, Graphs, Meters)	
E. Terminology (Medical, Electronic, Mechanical, Instrumentation)	

COURSE TOPICS (CONTINUED)	<u>CONTACT HOURS PER TOPIC</u>
IV. Electrodes, Transducers, Physiological Measurements	4
A. Electrodes (Micro, Skin Surface, Needle)	
B. Resistive Transducer and Ultrasonic Transducer Concepts	
C. Unbalanced Wheatstone Bridge Used With Resistance Transducers	
D. Displacement, Force and Pressure Transducers	
E. Differential Amplifier Operation	
F. Summary of Physiological Measurement	
V. Electrocardiographs	4
A. The Heart as a Potential Source	
B. The ECG Waveform	
C. Standard Lead System	
D. ECG Amplifiers	
E. ECG Read-Out Devices	
F. ECG machines	
1. Single Channel	
2. Multichannel	
3. Patient Cables	
4. Maintenance	
G. ECG Faults and Troubleshooting	
VI. Cardiac Stimulation and Life Support Equipment	4
A. The Heart	
B. Defibrillators	
1. Circuitry	
2. Cardioversion	
3. Testing	
C. Pacemakers	
1. Classification	
2. Testing	
D. Intra-aortic Balloon Pumps	
1. Mechanical Operation	
2. Electrical Operation	
E. Summary	

COURSE TOPICS (CONTINUED)	<u>CONTACT HOURS PER TOPIC</u>
VII. Physiological Pressure Measurements	4
A. Physiological Pressure	
1. What is Pressure?	
2. Measurement Techniques	
a. Direct Methods	
b. Indirect Methods	
B. Pressure Transducers	
C. Pressure Amplifiers	
1. Calibration	
2. Designs	
a. DC Amplifier	
b. Pulsed-Excitation Amplifier	
c. AC Carrier Amplifier	
3. Systolic, Diastolic, Mean Detector Circuits	
4. Differentiation (DP/DT) Circuits	
5. Automatic Zero Circuits	
D. Practical Problems in Pressure Monitoring	
VIII. Other Caridovascular Measurements	4
A. Cardiac Output Measurement	
1. Blood Flow Measurements	
2. Dilution Techniques	
B. Dilution Methods	
1. The Flick Method	
2. Dye Dilution	
3. Thermodilution	
4. Some Sample Computers	
C. Right-Side Heart Pressures	
D. Plethysmography	
E. Blood Flow Measurement	
F. Phonocardiography	
G. Vectorcardiography (VCG)	
H. Catheterization Laboratories	
IX. Patient Monitoring Systems	4
A. Special Care Units	
B. ICU/CCU Equipment	
C. Bedside Monitors	
D. Bedside Monitor Circuits	
1. Cardiotachometers	

COURSE TOPICS (CONTINUED)

CONTACT HOURS
PER TOPIC

2. Alarms	
3. Lead Fault Indicator	
E. Central Monitoring Consoles	
F. Auxiliary Equipment	
1. Multichannel Paper Recorders	
2. Numeric Displays	
3. Remote Oscilloscopes	
4. Memory Systems	
G. Radio Telemetry	
H. Summary	
X. Neonatal Monitoring Systems	4
A. Bedside Monitoring - Respiration	
B. Radiant Warmer Systems	
C. Incubator Systems	
D. Phototherapy Systems	
XI. Infusion Devices	4
A. Infusion Pump Systems - Volume Control	
B. Infusion Controller Systems - Rate Control	
C. Feeding Pump Systems	
D. New Developments - Insulin Pumps	
XII. The Respiratory System and Instrumentation	4
A. The Human Respiratory System	
B. Gas Laws	
C. Internal (Cellular) Respiration	
D. External (Lung) Respiration	
E. Organs of Respiration	
F. Mechanics of Breathing	
G. Parameters of Respiration	
H. Regulation of Respiration	
I. Unbalanced and Diseased States	
J. Environmental Threats to the Respiratory System	
K. Major Measurements of Pulmonary Function	
1. Respiratory Transducers and Instruments	
2. Spirometers	
3. Pulmonary Measurement Systems and Instruments	
XIII. Respiratory Therapy Equipment I	4

COURSE TOPICS (CONTINUED)

CONTACT HOURS
PER TOPIC

<ul style="list-style-type: none"> A. Diseased States Requiring Artificial Respiratory Therapy B. An Overview and Terms of Ventilation C. Historical Perspective of Artificial Respiratory Ventilation D. Medical Gases and Safety Systems E. Oxygen Therapy F. Intermittent Positive Pressure Breathing (IPPB) G. Artificial Mechanical Ventilation H. Accessory Devices Used in Respiratory Therapy Apparatus <ul style="list-style-type: none"> 1. Humidifiers 2. Vaporizers 3. Nebulizers 4. O₂ Analyzers I. Sterilization and Isolation Procedures in Respiratory Therapy Units 	4
<p>XIV. Respiratory Therapy Equipment II</p> <ul style="list-style-type: none"> A. Mechanical Ventilator Circuits <ul style="list-style-type: none"> 1. Pneumatics 2. Electrical B. Typical Faults and Maintenance Procedures for Ventilators 	4
<p>XV. Blood Gas Analysis</p> <ul style="list-style-type: none"> A. Blood Gas Analyzer <ul style="list-style-type: none"> 1. Specific Ion Electrodes PO₂, PCO₂ 2. Aspiration System 3. Differential Amplifier 4. Constant Temperature Water Bath 5. System Output B. Oximetry Systems 	4

LABORATORY TOPICS

1. Concepts of Preventive Maintenance
2. Electrical Safety and Measurement
3. Troubleshooting and Test Equipment
4. EGG Machines
5. Defibrillators
6. Pressure Monitors
7. Blood Flow Measurement Devices
8. Monitoring Systems
9. Neonatal Devices
10. Infusion Devices
11. Respiratory Measurement Devices
12. Respiratory Therapy Devices
13. Ventilators
14. Blood Gas Analyzers