DeVRY UNIVERSITY

Course Syllabus

Spring 2007

Course Title: Introduction to Bioengineering
Course Number: **BMET311**
Credit/Contact Hour: 4-2-5
Course Dependency: Prerequisite(s): EET240, BIOS160 Co-requisite(s): (none)

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Course Description

This course provides an introduction to applications of engineering in medicine and healthcare. The focus of the applications is to acquire, monitor and analyze the biomedical signals. The topics include: electrodes, biopotential measurements, ECG, EEG, pacemakers, defibrillators, pressure transducers, blood flow monitoring, sensor technology, ultrasonics, troubleshooting, filtering and electrical safety.

Textbooks and Materials

Textbook/s Title:	**Ed**	**Author**
INTRODUCTION TO BIOMEDICAL EQUIPMENT TECHNOLOGY	Curr	Carr & Brown

Terminal Course Objectives (TCOs):

Following are the objectives for this course. Individual faculty, based upon their experience and expertise may add to these objectives to meet local campus needs. Any such additions will be communicated to the class. While the instruction remains focused in helping students, accomplishing these objectives is a shared responsibility of students and faculty. The outcomes of this course will depend upon the motivation and capabilities of the students, sufficient time allocation for studying, and the effectiveness of that effort.

DeVry University is committed to the continual improvement of its curriculum and instruction and to meet the needs of students and employers in a rapidly changing global economy. Students, faculty, and the university must all be actively involved to accomplish these objectives, as well as the objectives of this particular course.

Every class is to some extent a unique interactive experience, which may cause some variance within the stated objectives, in either content or level. Individual faculty, based on their experience and expertise, are encouraged to add objectives, as they deem appropriate, and to communicate these directly to the class. The outcomes of the course will depend on the design of the course, the quality of instruction, and the motivation and capabilities of the students, including time available for studying and the effectiveness of the effort.

1. Given a list of engineering disciplines, compare and contrast the discipline of biomedical engineering in terms of the scope, R & D, Internet access, industry orientation, regulatory practices, and various memberships and societies.

2. Given a generic block diagram of the human-instrument interface of the biomedical type, identify each component and compare and contrast the characteristics of each.

3. Given a block diagram of a medical instrument, compare and contrast the role of the electronic circuit theory as applied to the instrument.

4. Given a biomedical transducer, determine the type and then compare and contrast the characteristics of this transducer with various other biomedical transducers of the same type.

5. Given a circuit model of a pair of biomedical electrodes, analyze the circuit for the impedance of each electrode and the differential voltage between the two electrodes.

6. Given a simplified block diagram of an ECG machine, compare and contrast the amplitudes of ECG waves for the standard lead connections and also compare and contrast the methods of reducing noise from the skin/electrode to the amplifiers.

7. Given an arterial blood pressure signal, design a mean arterial pressure detector circuit having systolic, diastolic and mean arterial pressure outputs.

8. Given blood flow signal, compute cardiac output and compare and contrast various techniques such as dye dilution and thermodilution in determining cardiac output.

9. Given the heart muscle undergoing a fatal arrhythmia in a patient, design a simple defibrillator circuit and compute the energy that is delivered to the patient.

10. Given a typical pacemaker signal detection functions and electrical output, identify the type of sensors/transducers and electrodes and their leads, and then compare and contrast the characteristics of the electrode design and configuration in relation to their purpose.

11. Given a lung air volume signal generated by a spirometer, identify the commonly measured volumes and then compare and contrast the types of sensing techniques available to detect a signal proportional to airflow.

12. Given a simplified block diagram of an eight-channel EEG system, identify each block and also compare and contrast the eight-channel EEG signals in terms of frequency and amplitudes.

13. Given an ultrasound transducer used for fetal monitoring, identify reflection, refraction and absorption phenomena as the ultrasound travels through the soft tissues.

14. Given three typical cases of microshock situations in a hospital, analyze the situations and then list the corresponding safety recommendations.

15. Given the description of a proposed new medical device, indicate the regulation that must be used to design it and suggest whether 510K or PMA documentation must be submitted.

Class Policies and Procedures:

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Attendance

Each student is required to attend every lecture and laboratory session in which he or she is enrolled. A swipe-card terminal (ATS) in each classroom is used to record attendance electronically. Students are responsible for arriving before class begins, sliding their identification card through the wall-mounted reader, and remaining for the duration of the course meeting. Students who are absent for two or more days should notify their Professor or assigned Academic Advisor in advance. Students who miss more than five (5) consecutive days of school are in violation of the DeVry attendance policy and will be dismissed. Unexcused absence in excess of 5 hours will result in a reduction of the final course grade by one letter.

Homework

Homework is due at the beginning of class (xx00 UTC). *Late homework is not accepted unless mitigating circumstances are present*. If this is the case, bring documentation (court papers, note on doctor's letterhead, etc.) Homework carries the weight of one major exam (100 points) in the course. Failure to do homework will do severe damage to your grade. (UTC=Universal Coordinated Time, or Standard World Time.)

Homework will be kept in a 3-tab paper folder, with the latest assignment in front. Your name, the course number, and the instructor's name must appear in clearly-readable form on the front of the folder.

Homework Performance Standards

- For problems involving calculations, all work must be shown. If a numerical answer is obtained without doing a calculation, state clearly that this is the case. For example: "By inspection, the potential is 25 Volts."

- When showing work for numerical problems, all defining equations will be stated first. The last step in the problem will be substitution of values into the equations. For example:

  Given V = 20V and R = 5 Ohms, find the current I.

  $I = \frac{V}{R}$ (Comment: The defining equation, Ohm's law, is stated.)

  $I = \frac{20V}{5\Omega} = \underline{\underline{4A}}$ (Comment: Note that units are clearly displayed for the answer.)

- When a numerical answer is given, it must be boxed or underlined and have correct units attached.

No credit will be given for any problems that have not been worked according to these instructions, or any additional instructions given by the instructor.

Make-Up Exams

No make up exams are given in BMET311 for any reason.

Course Grading Standards

There are 3 major exams, an unspecified number of quizzes given at random intervals, various homework assignments, and a final examination given in the 15th week of the course. Your grade will be determined as follows:

2 Highest Major Exams .....… 200 points (18% each, 36% total)

Quizzes/Homework.....…….. 100 points (18%)

Final Exam..... 150 points (28%)

Laboratory Portion……. 100 points (18%; See the Laboratory Schedule for details on lab report grading)

550 points total for course (100% total by eCollege gradebook)

Note: The lowest of the three major exams is "dropped" and does not count in the final grade calculation. No makeup exams are given. All examinations will be announced at least 1 week prior to administration. All students must take the final exam. A passing grade in lecture and laboratory is necessary in order to pass the course.

A final letter grade is to be awarded to each enrolled student in accordance with the 4.00 grading system shown below:

Letter Grade	***Percent of Total Points***	***Grade Points***
A	90 – 100%	4.00
B	80 – 89%	3.00
C	70 – 79%	2.00
D	60 – 69%	1.00
F	Below 60%	0.00

Academic Integrity Policy

Ideas and learning form the core of the academic community. In all centers of education, learning is valued and honored. No learning community can thrive if its members counterfeit their achievement and seek to establish an unfair advantage over their fellow students. The academic standards at DeVry are based on a pursuit of knowledge and assume a high level of integrity in every one of its members. When this trust is violated, the academic community suffers injury and must act to ensure that its standards remain meaningful. The vehicle for this action is the Academic Integrity Policy outlined in the *Student Handbook*.

The Academic Integrity Policy is designed to foster a fair and impartial set of standards upon which academic dishonesty will be judged. All students are required to read, understand, and adhere to these standards, which define and specify the following mandatory sanctions for such dishonest acts as copying, plagiarism, lying, unauthorized collaboration, alteration of records, bribery, and misrepresentation for the purpose of enhancing one's academic standing:

- The ***first recorded offense*** will result in the student receiving zero credit for the entire paper, exam, quiz, lab, homework assignment, or other graded activity in which the incident of academic dishonesty occurred. No partial credit may be given. Where the incident involved a graded assignment normally subject to a "drop" option, the student may not exercise that option.

- The ***second recorded offense*** will result in the student receiving a failing grade for the course in which the second offense occurs. The second offense need not be in the same course, program, or term as the first offense to invoke this sanction.

- The ***third recorded offense*** will result in the student being permanently expelled from the DeVry system. Again, the third offense need not be in the same course, program, or term as either the first or second offense to invoke the sanction.

Changes to Syllabus:

The contents of this syllabus are subject to change with appropriate notice to the students.

Weekly Course Schedule:

Week	Topics	Reading Assignment	Homework Assignments Due
1	Introduction - Human body electrical model. Electrical safety. FDA Regulations overview. IMPORTANT: Please read the web handouts and be prepared to discuss them for the first week's class.	Ch 1,3 + Notes Web Handout "Medical Electrical Safety" Web Handout "Medical Device Regulations"	
2	Circulatory system anatomy & physiology review. Fluid mechanics of the circulatory system.	Ch 2 + Notes Web Handout "Units_Rosetta"	HW#1
3	Cardiac output measurement - Fick principle, thermodilution.	Chapter 9 pp. 271 - 283	HW#2
4	EXAM #1 & Biomeasurement principles - sources of error; statistical representations; Auscultation.	Ch 6 + Notes	HW#3
5	Electrode electrical models, pressure measurement.		
6	Temperature measurement. Cellular electrophysiology. Cardiac cycle. Electrophysiological timing.		HW#4
7	ECG signals within the Einthoven triangle; determining cardiac electrical axis. ECG measurements, equipment, electrical field planes, and basic interpretations.	Ch 8 + Notes	
8	Peripheral blood flow measurement techniques. CO regulation. Plethysmography.	Ch 17 + Notes	HW#5
9	EXAM #2 & Introduction to pulmonary function. Pulmonary function measurement & assessment techniques. Spirometry clinical parameters.	Ch 12 + Notes	
10	Electronic techniques for spirometry	Ch 10, 11 + Notes	
11	Pacing / Cardioversion. Defibrillator circuitry. Power budgeting in pacemakers.	Ch 9 pp. 287 - 297 + Notes	
12	Ultrasound theory & electronic technques.	Notes	HW#6
13	Electronic design principles. Bioamplifier design principles.		HW#7
14	EXAM #3 & WRAPUP	None! Review for final.	