

**Biomedical Engineering
BMEN 4100 Biomedical
Mechatronics Syllabus
Spring 2023**

Instructor: Dr. Amir Jafari

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Office Hours: By appointment

Class Schedule: Tu/Th 11:30 am-12:50 pm

Catalog description:

3 hours credit. The students will be introduced to, and study electromechanical design and analysis as coupled with control systems. Sensor integration and some special topics in signal conditioning may be covered, as needed.

Major prerequisites by topic:

1. Electric circuits and components
2. Sensors and measurement systems
3. Error introduction and propagation
4. Basic statistical analysis
5. Continuous, classical controls

Topics covered:

1. Review of electric circuits and components
2. Introduction to analog signal processing
3. Introduction to digital circuits and microcontroller programming
4. Review of data acquisition
5. Review of sensors and measurement methods
6. Introduction to actuators
7. Introduction to mechatronic control architectures

Contribution of course to meet the professional component:

This course builds the foundation for preparing students to work professionally in the area of biomedical mechatronics devices.

Student Learning Outcomes:

- (i) an ability to apply knowledge of mathematics, science, and engineering
- (ii) an ability to identify, formulate, and solve engineering problems
- (iii) apply principles of engineering, basic science, and mathematics to model, analyze, design, and realize physical systems, components or processes; and work professionally in mechanical systems area.
- (iv) ability to define a mechatronic system, its primary elements, and to model a multi-energy domain system
- (v) ability to exercise a computational model of the mechatronic system and evaluate the system response

Textbook(s) and/or required material:

No required textbooks

Course Policies:

- Exam:
 - There will be no make-up exams except for medical emergency. You will need a note from a doctor that you had a genuine medical emergency. The content of the make-up exam may be different from the regular exam.
 - The schedule of Final Exam is set by UNT and should not be violated.
 - Honor code must be strictly followed in every exam.
 - All exams will be in-class and close book.
 - Students are allowed to bring a calculator to exam but **cannot** get laptop/computer/tablet.
 - Cell phones should be shut-off during exam. No exception to this rule for anybody.

Evaluation Methods:

- First Mid-Term Exam – 20%
- Second Mid-Term Exam – 30%
- Final Exam – 50%

UNT Policies and Resources:

- 1) no bathroom breaks during an exam (unless student provides medical note).
- 2) no electronic device (phone, smart watch, camera, electronic glasses, computer, unapproved calculator) on student body (in pockets, boots, clothing, etc) or within reach (under seat, on adjacent seat) during exam
- 3) if calculators are needed, students can only use approved calculators during exams, based on the FE exam approved calculator list

Exam Policy:

No bathroom breaks during exams. No electronic device (phone, smart watch, camera, electronic glasses, computer, unapproved calculator) on student body (in pockets, boots, clothing, etc) or within reach (under seat, on adjacent seat) during exam. It is considered cheating to have a phone, computer, or other electronic device accessible during an exam.

Approved Calculators for Exams

The FE exam calculator policy (<http://www.ncees.org>) will be used in this course. Only the models listed below may be used during exams.

Hewlett Packard - HP 33s and HP 35s models, but no others

Casio - all FX 115 models (must contain fx-115 in its model name)

Texas Instruments - all TI-30X and TI-36X models (must contain either TI-30X or TI-36X in its model name)

	Date	Topics	Comments
1	01/17/2023	Introduction- Basic Electronics Components (resistor-capacitor-inductor)	
2	01/19/2023	Basic Electronics Components (resistor-capacitor-inductor)-Kirchhoff's Laws	
3	01/24/2023	Voltage and Current Sources and Meters- Alternative Current Circuit Analysis- Impedance	
4	01/26/2023	Introduction to Semiconductors-Diode	
5	01/31/2023	Bipolar Junction Transistor	
6	02/02/2023	First Mid-term Exam	
7	02/07/2023	Introduction to System Response- Amplitude Linearity- Phase Linearity	
8	02/09/2023	Bandwidth- Fourier Series Representation	
9	02/14/2023	Dynamic Characteristic of a System- Zero Order Systems- First Order Systems	
10	02/16/2023	Second Order Systems- System Modeling and Analysis	
11	02/21/2023	Operational Amplifiers- Analog Calculations	
12	02/23/2023	Digital Representations- Logic Gates	
13	02/28/2023	Boolean Algebra	
14	03/02/2023	Design of Logic Networks	
15	03/07/2023	Sequential Logics	
16	03/09/2023	Second Mid-term exam	
17	03/14/2023	NO class	Spring Break
18	03/16/2023	NO class	Spring Break
19	03/21/2023	Introduction to Actuators- Electromagnetic Principles	
20	03/23/2023	Solenoids and Relay- Electric Motors	
21	03/28/2023	Permanent Magnet DC motors	
22	03/30/2023	Stepper Motors- Hydraulics and Pneumatics	
23	04/04/2023	Actuators for Biomedical Applications	
24	04/06/2023	Variable Stiffness Actuators-Series Elastic Actuators	
25	04/11/2023	Variable Stiffness Actuators- Soft Actuators	
26	04/13/2023	Introduction to Sensors- Position	
27	04/18/2023	Linear variable Differential Transformers- Digital Optical Encoders	
28	04/20/2023	Stress and Strain Measurements	
29	04/25/2023	Vibration Measurements	
30	04/27/2023	Acceleration Measurements	
31	05/02/2023	Review Session	
32	05/09/2023	Final Exam	10:30am-12:30pm