1. Course title/number, number of credit hours	
Innovations in Biomedical Applications(CIS,2930,EEL 1935003_2016R_61477)	# of credit hours 3

2. Course prerequisites, corequisites, and where the course fits in the program of study
Sone knowledge in Biology and Chemistry

3. Course logistics
Term: Summer 2020 (Jun 8-26th 2020) This is a classroom lecture course with some dry and wet lab (hands-on)practice *Class location and time* EE96 #room TBA (Mon, Wed, Fri, (9:30AM-12:30PM and1:30 PM-4:30 PM) This course has limited design content.

4. Instructor contact information	
Instructor's name *Office address* *Office Hours* *Contact telephone number* *Email address*	Mirjana Pavlovic, MD, PhD EE 96, #515 Tue, Thurs, 10:00-12:00 AM 562-297-2348 mpavlovi@fau.edu

5. TA contact information	
TA's name *Office address* *Office Hours* *Contact telephone number* *Email address*	TBD

6. Course description
This is partly demonstrative and partly hands – on Biomedical Engineering based course designed for students interested in advances in Biomedical engineering in both: Wet Lab and Computerized aspects (model simulation, machine learning, artificial intelligence) of biological/medical phenomena. No prior background in Lab or Computer methods are assumed, but Biology and Chemistry are prerequisites… The Biomedical part is covered through particular lectures from established Intro to Bioengineering and Tissue Engineering courses derived and elaborated from MS program at FAU, as well as spectrum of new lectures given by experts in their fields such as Stem cell Application, Biophotonics, Magnetotherapy, Autism improvement, Artificial Intelligence, Machine learning, etc. . The Computer based material and the design methods are covered through MATLAB and Simulink software simulation sessions and lectures. Computer modeling and simulation techniques are playing an increasingly central role in changing both the way medicine is taught and the way it is practiced. Fundamental to the art and science of modeling and simulation is an underlying assumption that insight into system behavior can be developed or enhanced from a model that adequately represents a selected subset of the system's attributes. The course lectures and labs experiences culminate in a design project competition of topics/models chosen and applied for presented simulation either theoretical topic presentation.

7. Course objectives/student learning outcomes/program outcomes

Course objectives	The course covers the fundamentals of Biomedical engineering potentials through lectures, calculative approaches, and practical 3-D printing of the prosthesis known as Bionic glove, as well as MATLAB and Simulation lectures dedicated to specific models: classical (Malthusian, Verhulst, Predator-Prey), and modernized, (Excel spreadsheet data presentation, Monte Carlo investment model, Genetic drift model, etc.). By combining lectures and practical computer lab activities and animations, students will get the insight into the integration of simulation techniques with other types of applications. They will learn about stem cells, scaffolds and molecules of intracellular interaction in medical applications of Tissue Engineering, basic calculations necessary for engineering different cell-culture media, determining optimal cell patterns for defected tissues, and essential breakthroughs in significant avenues of this expanding area. They will also learn about graphical presentation of different models through MATLAB, based on differential equations. Students will explore the latest features and a customizable sets of block libraries that will help them to establish/complete the models, through Simulink program (library of necessary components for given model). Students will spend half of their class time in the lab conducting either guided simulations, doing analytical calculative solutions, presenting data in Excel, or doing rapid prototyping on 3D printer. The other half of the class time will be divided between the lectures and demonstration or hand-on wet-lab practice necessary for correct understanding of certain procedures in Biomedical engineering (cell staining, visualization and counting using specific microscopes, magnetic bead cell/protein/antibody isolation, Phastgel electrophoresis and Western Blot protein analysis, PCR –DNA amplification, wireless spectrometry and use of devices based on different sensors for calculative quantitativization of different relevant parameters(pH,CO_2 ,etc.). Due to the special time format constraints (9 full class days spread over three weeks) the course is fast paced and homework-intensive (team lab technical reports/presentations and individual computer and lab assignments).
Student learning outcomes & relationship to ABET a-k objectives	a) Students will develop deep understanding of the most significant breakthroughs in Biomedical engineering applied nowadays in medical/clinical arena and in scientific search for improvement of human health. b) They will learn the basic calculative and protocolled operations used in the Wet Biomedical engineering Lab and be introduced to high technical novelties in Biomedical engineering Lab instrumentation and devices at the level of wireless systems. d) Students will be exposed to experience of 3D printing and do the basic assembly and evaluation of products (prostheses, or bionic hands)

	c) They will also develop basic understanding of the modeling processes through MATLAB and Simulink, e.g. how to integrate the programs and simulate the linear and non-linear changes within particular models, based on specific parameters
	b) They will get a good understanding of basic linear and nonlinear dynamic properties, normalization (scale changes), computer-aided analysis, simulation and control of selected physiological processes and medical/biological systems
	c) Students will be able to not only graphically present manifestations of specific facet of given medical/biological phenomena, but also to manipulate/tune changes in the graph (background, labeling, and colors).
	d) Students will form the lab teams and learn how to research and present the topics, collect the experimental data and how to process it and present in their team reports and homeworks

8. Course evaluation method

3Homeworks - 36 % 3 Lab Reports - 28 % 4 equally weighted quizzes - 21 % Instructor's Assessment of Lab Participation and work quality 7% Instructor's Assessment of the Final Project (team) 8%	*Note*: The minimum grade required to pass the course is C.

9. Course grading scale

Grading Scale:
90 and above: "A", 87-89: "A-", 83-86: "B+", 80-82: "B", 77-79 : "B-", 73-76: "C+", 70-72: "C", 67-69: "C-", 63-66: "D+", 60-62: "D", 51-59: "D-", 50 and below: "F."

10. Policy on makeup tests, late work, and incompletes

Make up tests are impossible due to very intensive pace pf course .Late work will not be tolerated except with physician's confirmation of affected health.

11. Special course requirements

. Submission of Homework, Computer Lab Reports, and Presentations requirements:

1. Homeworks are due the morning of the next class day, individually. They should be brief and involve answers to questions and solutions to the problems.
2. The lab reports (both computer and wet lab) are due also the morning of the next class, by each team. Each team should submit one brief report per experiment. The report should include the relevant simulation results in two cases and one Excel result.
3. The last report on either computer model or literature searched topic should be submitted last day of course in written and PP form and presented orally by each team.
4. All students are expected to be active participants of the team. Students who consistently let their lab partners do most of the work may lose the entire percentage of the grade in corresponding category.

12. Classroom etiquette policy

University policy requires that in order to enhance and maintain a productive atmosphere for education, personal communication devices, such as cellular phones and laptops, are to be disabled in class sessions.

13. Disability policy statement

In compliance with the Americans with Disabilities Act (ADA), students who require special accommodations due to a disability to properly execute coursework must register with the Office for Students with Disabilities (OSD) located in Boca Raton campus, SU 133 (561) 297-3880 and follow all OSD procedures.

14. Honor code policy

Students at Florida Atlantic University are expected to maintain the highest ethical standards. Academic dishonesty is considered a serious breach of these ethical standards, because it interferes with the university mission to provide a high quality education in which no student enjoys unfair advantage over any other. Academic dishonesty is also destructive of the university community, which is grounded in a system of mutual trust and place high value on personal integrity and individual responsibility. Harsh penalties are associated with academic dishonesty. See University Regulation 4.001 at www.fau.edu/regulations/chapter4/4.001_Code_of_Academic_Integrity.pdf

15. Required texts/reading

1.Instructor's handouts
2. Personal notes

16. Supplementary/recommended readings

Modeling and Simulation in Medicine and the Life Sciences
(2nd Edition)
Frank C. Hoppensteadt and Charles S. Peskin
Springer, New York, 2002.

17. Course topical outline, including dates for exams/quizzes, papers, completion of reading

Monday, June 8

9:30-9:45   Orientation
10:00-11:25   Lecture:
Introduction to Biomedical engineering: general remarks
Examples of applications in research and clinical arena
- Autism (Bassem Alhalabi)
11:30-12:30
- Autoimmune diseases and cancer
12:30-1:30   Lunch

1:30-4:30   Computer Lab: (Access to MATLAB and Simulink, Willam van Dam/Hanqi Zhuang if necessary) Lecture: (Differences between Computer and Wet Lab used in Biomedical Engineering: MATLAB and SIMULINK .Modeling and Simulation in Medicine: State of the art.
COMPUTER LAB: tutorials (via analysis of Population Growth Dynamics): Malthusian Growth, Verhulst Logistic curve, Predator-Prey models and their Applications in Biomedical Engineering: cell culture exponential growth, confluent and sub confluent cultures, and cellular "cannibalism".

Wednesday, June 10

9:30 -12:30   Lecture :
- Glycolysis and Respiration as basic cell functions and biomedical targets
12:30-1:30   Lunch
1:30-4:00   Computer Lab: Excel Spreadsheet, other Simulink models presentation.

Friday, June 12
9:30-12:30 Lecture:
- The use of Stem Cells (SC) in Medical arena: entities, patterns, optimization and transplantation
- Concepts of Cell and Regenerative therapy
12:30-1:30   Lunch
1:30- 4:30   Computer lab: 3-D PRINTING I

Monday, June 15
9:30-12:30   Lectures:
- Cancer Stem Cell Concept and Targeted therapy
- Concepts of Drug Delivery (Mechanisms of targeted drug delivery: animations)
- Remote control
12:30- 1:30 Lunch
1:30-4:30   Computer Lab:3-D PRINTING II

Wednesday, June 17

9:30-13:30 Lectures :
- Tissue engineering as essential topic in Biomedical engineering
- Viral detection at the point of care level: innovative technologies(Waseem's group)
12:30-1:30 Lunch
1:30-4:30   Wet Lab in Biomedical Field: Wet lab calculus: media, concentrations, cell growth. Wireless SPEC. Measurement and calculation of concentration.

Friday, June 19

9:30-12:30   Lectures: Breakthroughs in Biomedical Engineering with Emphasis on Biomedical
                Technologies
- Nanotechnology,
- Biomaterials, (Dr Kevin Kang)
- Bioinstrumentation,
- Bioimaging

12:30-1:30   Lunch

1:30-4:30   Lab: SENSORS (theory: wireless sensors, practice with different
    sensors).Concentration.

Monday, June 22

9:30 -12:30   Lecture :The computer integration in Biomedical arena:
- Introductory remarks (William Hahn and Elan Badernholtz)
- Artificial Intelligence (Sharmistha Chatterjee)
- Machine Learning (Hanqi Zhuang)
- Signal transduction in heart and brain (Behnaz Gorhaani):therapeutical approach

12:30-1:30   Lunch

1:30-4:30   Computer/Wet Lab: Modern Equipment (Countess, Zoe, Fxp, Magnetic beads)

Wednesday, June 24

9:30-12:30   Lecture:
- Matter and Material in Universe : what did we learn?
- Magnetotherapy.
- Biophotones and photon therapy (Sareh Taebi).

12:30-1: 30   Lunch

1:30-4:30   Lab (Wet Lab: PCR)

Friday, June 26

9:30-12:30 Lecture: Student team presentations: chosen topics either from mathematical models or
    Bioengineering topics

12:30-1:30   Lunch

1:30-4:30   Lab: Open Discussion –different topics

Slight modifications are possible dependent on conditions.