Biomedical Applications of Low Temperature Plasmas
ECE 563 - BIOL 596
Spring Semester 2013
Tuesday and Thursday 1:30 – 2:45 pm
Kaufman Hall Room 215

Instructors
M. Laroussi (mlarouss@odu.edu)
W. Hynes (whynes@odu.edu)
N. Barekzi (nbarekzi@odu.edu)

Office Location
M. Laroussi: 231 Kaufman Hall, 683-6369
W. Hynes: 110 Mills Godwin Building, 683-3595
N. Barekzi: LPEI Labs, 1014 W. 46th Street, 683-6707

Office Hours by Appointment

Course Description
This 3 credit hour course is cross listed between ECE and Biology. It is designed to be taken by senior undergraduate students and first year graduate students. The course contents are multidisciplinary, combining materials from engineering and the biological sciences. The course covers an introduction to the fundamentals of non-equilibrium plasmas, low temperature plasma sources, and cell biology. This is followed by a detailed discussion of the interaction of low temperature plasma with biological cells, both prokaryotes and eukaryotes. Potential applications in medicine such as wound healing, blood coagulation, sterilization, and the killing of various types of cancer cells will be covered.

Suggested Text
Plasma Medicine: Applications of Low-Temperature Gas Plasmas in Medicine and Biology

Blackboard
This course is linked on Blackboard. Please check often the Blackboard for announcements, important course documents, certain assignments and other pertinent information. All students must be registered for this course to obtain access to Blackboard and the information found there-in.

Attendance and Honor Code
Class attendance is mandatory. All students are expected to adhere and abide by the Old Dominion University Honor Code which states that, “We, the students of Old Dominion University, aspire to be honest and forthright in our academic endeavors. Therefore, we will practice honesty and integrity and be guided by the tenets of the Monarch Creed. We will meet the challenges to be beyond reproach in our actions and our words. We will conduct ourselves in a manner that commands the dignity and respect that we also give to others.”

Evaluation and Requirements
Grades will be assigned as follows:

| Test 1 | 25% |
| Test 2 | 25% |
| Final Exam | 30% |
| Term Paper | 20% |

The Final Exam will be scheduled during exam week May 2-9 in the regular classroom. The Term Paper will consist of a 10 page written report (60%) and a 15 minute oral presentation (40%).
General Course Contents
The following is a general outline of the course and may be adjusted according to time and material being covered by the different instructors.

Fundamentals of non-equilibrium plasmas
- Introduction
  - Plasma ignition and sustainment
  - Modes and operation regimes
  - Plasma chemistry-reactive species

Non-equilibrium plasma sources
- Cold and hot plasmas
- Non-equilibrium plasmas sustained at different frequencies
  - Dielectric barrier discharges
  - Capacitively coupled discharges
  - Inductively coupled discharges
  - Afterglow plasmas: plasma jets

Test 1

Basic cell biology
- Cell structures: prokaryotes versus eukaryotes
- Membrane, proteins, surface adhesion
- Common diseases

Common healthcare challenges
- Hospital acquired infection
- Microbial, fungal, and virus related diseases
- Prion diseases
- Wounds
- Cancer

Test 2

Plasma Decontamination of surfaces
- Microbial inactivation
- Biomolecule inactivation
- Sterilization of medical instruments
- Skin sterilization

Plasma-cell interaction: prokaryotes
- Direct versus indirect exposure
- Effects of neutral species
- Effects of UV radiation
- Effects of charged particles

Plasma-cell interaction: eukaryotes
- Cell death: necrosis and apoptosis
- Cell detachment
- Cell proliferation
- Adhesion proteins
- Killing of cancers cells
Plasma Based Applications
  Wound healing
  Cell proliferation
  Tissue repair
  Safety consideration (UV)
  Dental applications
  Cancer
  Cosmetic applications

Final Exam