Department of Computer & Electrical Engineering and Computer Science
Florida Atlantic University
Course Syllabus

1. Course title/number, number of credit hours	
Nanobiotechnology EEE 4424	# of credit hours = 3
2. Course prerequisites, corequisites, and where the course fits in the program of study	
Prerequisites: Department Permission	
3. Course logistics	
Term: Spring 2019 Location: TBD	
4. Instructor contact information	
Instructor's name *Office address* *Office Hours* *Contact telephone number* *Email address*	Waseem Asghar, PhD Bldg. EE 96/ Room 435 TBD 561-297-2800 wasghar@fau.edu
5. TA contact information	
TA's name *Office address* *Office Hours* *Contact telephone number* *Email address*	TBD
6. Course description	
The sensing and characterization of biological entities, processes and events, with novel nanoscale devices and nano-object mediated modalities, will have immediate and far reaching impacts. This course covers the fundamentals of nanotechnology in biological and biomedical research. The course work is approached from an engineering perspective offering insights on the details of nanoscale fabrication processes as well as cell biology. The basics of biology and chemistry, with focus on how to engineer the behavior of molecules at the nanoscale, are also introduced and analyzed. Concepts and processes related to BioMEMS and microfluidics will also be explained.	
7. Course objectives/student learning outcomes/program outcomes	
Course objectives	To introduce the students to the concepts of nanobiotechnology and its applications in biological and biomedical engineering, pharmaceuticals, diagnostics, and public health. Students will also learn material properties of natural and synthetic materials and their applications in biomedical engineering.
8. Course evaluation method	
5 Homework assignments (4% each): 20% Key paper review: 20%	For key paper review, each student has to find a key paper in nanobiotechnology which has first

Group research proposal: 20% Midterm exam: 20% Final exam: 20%	reported some fundamentally novel mechanism, method, or technique which laid the foundation of significant work later on. Student has to make a presentation on this paper and present in class. For group research proposal, students will be divided into groups of 2-3 students. Each group will propose an interesting topic related to latest key advances in the field of Nano Biotechnology. Each group will present and defend their proposal topic in class.

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

Students are strongly suggested to inform the instructor in advance in the case of emergency (if possible). Makeup exams are given only if there is solid evidence of a medical or otherwise serious emergency that prevents the student of participating in the exam.

Students must turn in homework, assignment and projects on time. Students will lose 25% (after 1 day) and 50% of marks (after 2 days) if they turn in late. Submissions are not accepted after 2nd day of due date.

11. Special course requirements

NA

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. Attendance policy statement

Students are expected to attend all of their scheduled University classes and to satisfy all academic objectives as outlined by the instructor. The effect of absences upon grades is determined by the instructor, and the University reserves the right to deal at any time with individual cases of non-attendance.
Students are responsible for arranging to make up work missed because of legitimate class absence, such as illness, family emergencies, military obligation, court-imposed legal obligations or participation in University-approved activities. Examples of University-approved reasons for absences include participating on an athletic or scholastic team, musical and theatrical performances and debate activities. It is the student's responsibility to give the instructor notice prior to any anticipated absences and within a reasonable amount of time after an unanticipated absence, ordinarily by the next scheduled class meeting. Instructors must allow each student who is absent for a University-approved reason the

opportunity to make up work missed without any reduction in the student's final course grade as a direct result of such absence.

14. Disability policy statement

In compliance with the Americans with Disabilities Act Amendments Act (ADAAA), students who require reasonable accommodations due to a disability to properly execute coursework must register with Student Accessibility Services (SAS) and follow all SAS procedures. SAS has offices across three of FAU's campuses – Boca Raton, Davie and Jupiter – however disability services are available for students on all campuses. For more information, please visit the SAS website at www.fau.edu/sas/.

15. Counseling and Psychological Services (CAPS) Center

Life as a university student can be challenging physically, mentally and emotionally. Students who find stress negatively affecting their ability to achieve academic or personal goals may wish to consider utilizing FAU's Counseling and Psychological Services (CAPS) Center. CAPS provides FAU students a range of services – individual counseling, support meetings, and psychiatric services, to name a few – offered to help improve and maintain emotional well-being. For more information, go to http://www.fau.edu/counseling/

16. Code of Academic Integrity policy statement

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 an unfair advantage over any other. Academic dishonesty is also destructive of the university community, which is grounded in a system of mutual trust and places high value on personal integrity and individual responsibility. Harsh penalties are associated with academic dishonesty. For more information, see University Regulation 4.001. If your college has particular policies relating to cheating and plagiarism, state so here or provide a link to the full policy—but be sure the college policy does not conflict with the University Regulation.

17. Required texts/reading

No textbook is required

18. Supplementary/recommended readings

Books:

Mauro Ferrari Ph.D., Abraham P. Lee, L. James Lee: *BioMEMS and Biomedical Nanotechnology,* ISBN: 978-0-387-25563-7 (Print) 978-0-387-25842-3 (Online), 2006

Iqbal, Samir M., Bashir, Rashid (Eds.): *Nanopores Sensing and Fundamental Biological Interactions*, ISBN 978-1-4419-8252-0, 2011

Research Articles:

M. Sher, R. Zhuang, V. U. Demirci, W. Asghar, "Paper-based analytical devices for clinical diagnosis: recent advances in the fabrication techniques and sensing mechanisms," Expert Review of Molecular Diagnostics, Accepted, DOI: 10.1080/14737159.2017.1285228 (2017)

W. Asghar, H. Shafiee, V. Velasco, V. R. Sah, S. Guo, R. El Assal, F. Inci, A. Rajagopalan, M. Jahangir, R. M. Anchan, G. L. Mutter, M. Ozkan, C. S. Ozkan, and U. Demirci "Toxicology Study of Single-walled Carbon Nanotubes and Reduced Graphene Oxide in Human Sperm," Scientific Reports, vol 6, article 30270 (2016)

K. Rappa, HF Rodriguez, GC Hakkarainen, RM. Anchan, GL. Mutter, W. Asghar, "Sperm processing for advanced reproductive technologies: Where are we today?", Biotechnoloy Advances, doi:10.1016/j.biotechadv.2016.01.007 (2016)

M. Safavieh, C. Coarsey, N. Esiobu, A. Memic, J. Mahesh, H. Shafiee, W. Asghar, "Advances in Candida Detection Platforms for Clinical and Point-of-Care Applications", Critical Reviews in Biotechnology, DOI:10.3109/07388551.2016.1167667 (2016)

W. Asghar, M. Yuksekkaya, H. Shafiee, M. Zhang, M. Ozen, F. Inci, M. Kocaculak, U. Demirci, "Engineering long shelf life multi-layer biologically active surfaces on microfluidic devices for point of care applications", Scientific Reports, 6: 21163 (2016)

M. Safavieh, M.K. Kanakasabapathy, F. Tarlan, M. Ahmed, M. Zourob, W. Asghar#, and H. Shafiee#, "Emerging Loop-mediated Isothermal Amplification-based Microchip and Microdevice Technologies for Nucleic Acid Detection", ACS Biomaterials Science and Engineering", vol. 2, no. 3, 2016

W. Asghar*#, R. EL Assal*, H. Shafiee, S. Pitteri, R. Paulmurugan, and U. Demirci#, "Engineering cancer microenvironments for in vitro 3-D tumor models", Materials Today, vol 18, no. 10, (2015)

H. Shafiee, W. Asghar, F. Inci, M. Yuksekkaya, M. Jahangir, M. H. Zhang, N.G. Durmus, U.A. Gurkan, D. R. Kuritzkes, and U. Demirci, "Paper and flexible substrates as materials for biosensing platforms to detect multiple biotargets," Scientific Reports, 5, (2015)

9. W. Asghar, V. Velasco, J.L. Kingslye, M.S. Shoukat, H. Shafiee, R.M. Anchan, G.L. Mutter, E. Tuzel, and U. Demirci, "Selection of functional human sperm with higher DNA integrity and fewer reactive oxygen species," Advanced HealthCare Materials, vol 3. no. 10 (2014)

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

Weekly Schedule	Topics
Week 01	Introduction to Nanobiotechnology, historical prospective, solid-state fabrication, Moore's law and its implication in bioengineering. Basic semiconductor materials, Crystal structure, Miller indices, Crystalline materials.
Week 02	Standard fabrication processes and modules, oxidation (wed and dry), oxide properties, Photolithograpy Projection Lithography, Pitch limit and diffraction, Light sources
Week 03	Doping, Diffusion, Ion Implantation, dry etching, wet etching, Isotropic and anisotropic etching. Deep reactive ion etching, LPCVD, PECVD, PVD

	HW-1
Week 04	Trade-offs in lithography, next generation lithography. X-Ray lithography, XPS, Auger electron spectroscopy, EUV lithography, Proximal X-ray lithography
Week 05	E-beam lithography, Focused ion beam lithography, Projection e-beam and ion beam lithography Scanning probe lithography, atomic force lithography **Key paper review nomination**
Week 06	Dip pen lithography, AFM lithography by local probe oxidation, STM lithography Soft lithography, contact printing, PDMS properties **HW-2**
Week 07	Micro transfer molding, replica molding, PDMS issues, CD based fluidics Nanoimprint lithography, step and flash lithography
Week 08	Biomolecules, cells and organelles, chemical structure of phospholipids Functional groups, structure of nucleic acids, genes, electronics properties of nucleic acids, aptamers **HW-3**
Week 09	DNA structure and fundamentals, human genome project **Midterm Exam**
Week 10	**Presentations for Key Paper Reviews**
Week 11	DNA microarrays, Integration of bionano, need to biosensing, electronic properties of biomaterials Molecular sensing, DNA hybridization, Annealing, Polymerase chain reaction (PCR), DNA replication and amplification. **HW-4**
Week 12	Real-time PCR, SYBR staining, Taqman, Scorpian, RT-PCR, PCR on-chip, microfluidics Next generation sequencing, ion torrent technology, Solid-state and biological nanopores for DNA analysis
Week 13	**Group Research Proposal Presentations**
Week 14	Gene translation and expression (mRNA, tRNA, rRNA) Types and structure of protein, types of amino acids, surface funcationalization with protein and DNA/RNA probes

	HW-5
Week 15	Nanowires, synthesis, nanowire biosensors Quantum dot confinement, carbon nanotubes and graphene, synthesis and their applications in biomedical engineering
	Final Exam