FLORIDA ATLANTIC UNIVERSITY

NEW COURSE PROPOSAL
Undergraduate Programs

Department Electrical Engineering and Computer Science

College Engineering and Computer Science

*(To obtain a course number, contact **erudolph@fau.edu**)*

UUPC Approval 2-28-22
UFS Approval _____
SCNS Submittal _____
Confirmed _____
Banner Posted _____
Catalog _____

Prefix BME

Number 4574

(L = Lab Course; C = Combined Lecture/Lab; add if appropriate)

Lab Code

Type of Course: Lecture

Course Title: Introduction to Nanobiotechnology

Credits *(Review Provost Memorandum)*: 3

Effective Date *(TERM & YEAR)*: Fall 2022

Grading *(Select One Option)*
- **Regular** (●)
- **Pass/Fail** ( )
- **Sat/UnSat** ( )

Course Description *(Syllabus must be attached; Syllabus Checklist recommended; see Guidelines)*

See attached syllabus for course description information.

Prerequisites, with minimum grade*

Undergrad Senior level in engineering and/or physical/biological sciences

Corequisites

Registration Controls *(Major, College, Level)*

Default minimum passing grade is D-.** **Prereqs., Coreqs. & Reg. Controls are enforced for all sections of course

WAC/Gordon Rule Course

( ) **Yes** (●) **No**

WAC/Gordon Rule criteria must be indicated in syllabus and approval attached to proposal. See WAC Guidelines.

Intellectual Foundations Program (General Education) Requirement *(Select One Option)*

None

General Education criteria must be indicated in the syllabus and approval attached to the proposal. See GE Guidelines.

Minimum qualifications to teach course

PhD in CS, CE or EE or a related field

Faculty Contact/Email/Phone

Hanqi Zhuang,zhuang@fau.edu,5612973413

List/Attach comments from departments affected by new course

Approved by	***Date***
Department Chair	11/8/21
College Curriculum Chair Hongbo Su	
College Dean	2-12-22
UUPC Chair Ethlyn Williams	2-28-22
Undergraduate Studies Dean Daniel Meeroff	2-28-22
UFS President	
Provost	

Email this form and syllabus to mjenning@fau.edu seven business days before the UUPC meeting.

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

1. Course title/number, number of credit hours	
Introduction to Nanobiotechnology - BME 4574	3 credit hours
2. Course prerequisites, corequisites, and where the course fits in the program of study	
Prerequisites: Undergrad Senior level in engineering and/or physical/biological sciences	
3. Course logistics	
Term: TBD *Class location and time:*	
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.
Student learning outcomes & relationship to ABET 1-7 outcomes	TBD
8. Course evaluation method	
5 Homework assignments (4% each): 20% Key paper review: 20% Group research proposal: 20% Midterm exam: 25% Final exam: 15%	For key paper review, each student has to find a key paper in nanobiotechnology which has first 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

N/A

12. Classroom etiquette policy

To enhance and maintain a productive atmosphere for learning, personal communication devices such as cell phones are to be disabled during 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. After two full weeks of face-to-face instruction with consecutive 'no show' of any students in person in the classroom, the modality of this course section may be changed to remote instruction only at the discretion of the university.

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 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.

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 (and associated readings)

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	