

EE 428/528 BioMEMS & Lab-On-a-Chip (LOC) (Fall 2017)

Course Description EE 428/528 BioMEMS & Lab-on-a-chip, Lecture, 3 credits
Covers various commonly used micro/nanofabrication techniques, microfluidics, various chemical and biochemical applications such as separation, implantable devices, drug delivery, and microsystems for cellular studies and tissue engineering. Discusses recent and future trends in BioMEMS and LOC. Students will gain a broad perspective in the area of micro/nano systems for biomedical and chemical applications.

Time/Location Fall 2017, M/W, 12:30 PM - 1:50 PM, Norton 213

Instructor Kwang W. Oh, Ph.D. (kwangoh@buffalo.edu)
SMALL (Sensors and MicroActuators Learning Lab), <http://www.SMALL.buffalo.edu>
Department of Electrical Engineering, University at Buffalo (SUNY at Buffalo)
113C Davis Hall, North Campus, Buffalo, NY 14260

Office Hours M/W 10:00 AM – 12:00 PM, right before the class, **113C Davis Hall** or by appointment

Prerequisites Senior undergraduate or graduate standing in engineering, medicine, biomedical sciences, and natural sciences

Course Learning Objectives - By the end of the course, students should be able to:	Student Outcomes
Review BioMEMS fabrication	a, c, k
Identify miniaturization issues on life sciences	c, k
Review various microfluidic platforms	c, k
Demonstrate creative solutions at the interface of biology and technology	c, k

Student Outcomes	a	b	c	d	e	f	g	h	i	j	k
Score	1		3		2	1	1	1			3

* 3 – Strongly Supported, 2 – Supported, 1 – Minimally Supported

(a) an ability to apply knowledge of mathematics, science, and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
(d) an ability to function on multidisciplinary teams
(e) an ability to identify, formulate, and solve engineering problems
(f) an understanding of professional and ethical responsibility
(g) an ability to communicate effectively
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(i) a recognition of the need for, and an ability to engage in life-long learning
(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Textbooks Class notes and Handouts (see UBLearn).

TA Mr. Domin Koh (dominkoh@buffalo.edu), 233 Davis Hall
Office Hours: M/W 2:00 – 4:00 pm, 233 Davis Hall, or by appointment

Grading Professionalism (see an e-mail from Dean) & Attendance: 10% (if you miss one lecture –0.5%),
Presentation 1 (5-min): 25%, Presentation 2 (10-min): 30%, Final Exam (60-min): 35%
Grading for EE428 will be done within the pool of “undergraduate students”. Grading for EE528 will be done within the pool of “graduate students”.

Presentation You should send **your presentation files (ppt and embedded video clips) to “kwangoh@buffalo.edu” with a title “[EE 428/528]” from your buffalo.edu e-mail account at least by 10:00 am on your presentation date.**

1. Presentation 1 (5-min): Students will present their works, exactly 5 min long. Pick one random noun from a dictionary. The noun must begin with the same letter that begins your last or first name. For example, Kwang W. Oh would choose nouns that begin with the letter “K” or “O”. Now, add micro-, nano-, or bio- to the beginning of the noun, and speculate on any potential usefulness of the technology or application. Remind that you have to present **innovative, creative, practical ideas that someone has not proposed yet to the world.**

2. Presentation 2 (10-min): All students present the following assignments, approximately 10 min long. Choose an innovative BioMEMS/LOC system/device/application; Come up with a solution of a device/system that the students might think works better than existing solutions. Remind that you should not present incremental ideas, you have to invent a totally-new thing and present it.

The grading (instructor: 50%, students: 50%) for the two presentations will be based on
(1) the uniqueness and originality of your selections (40%): *Is the proposed idea unique and original? Did he/she propose it for the first time as far as you know? Is it really useful in some applications?* This is most important part. Breakthrough idea and innovative (your own) approach is required. Please google/search articles, journals, patents, products,..., if someone already did the thing you propose or not. An incremental approach might be acceptable, but a totally-new approach will be better if you want to have higher points.

(2) realistic and detailed approach (30%): *Are there enough discussions on challenges and solutions to be able to make/fabricate/realize the idea?* The topic should be “narrow and specific”. So you may be able to realize your ideas within 2 years (or 4-5 years). I don’t want to hear broad ideas or concepts.

(3) presentation skills (presentation structure, easy understanding, reference, exact 5-min or 10-min length, questions/answers,...) (30%): *Does he/she entertain, inform, persuade, and/or sell the proposed idea effectively within the given time (5-min or 10-min)?* You have to convince your idea to students and of course entertain them too.

The presentation structure could be (for example):

1. Current approach and problem
2. Your unique approach/design/solution
3. What are the technical challenges and potential solutions to realize the proposed idea?
4. Detailed plan to challenge/solve the idea
5. Conclusion and impact (so what ?)
6. **Reference (please list all references in each presentation page if they (photos, images, ideas, data,...) are not from your own ones)**

Schedule

The schedule is subject to change and changes to the published schedule will be announced in class. Schedule for the two presentations will be announced.

W	Lecture	Date		Title	Presentation
1	[01]	08/28/17	M	Syllabus / Introduction to MEMS	
	[02]	08/30/17	W	Introduction to BioMEMS	
2		09/04/17	M	No Class (Labor Day)	
	[03]	09/06/17	W	MEMS Fabrication	
3	[04]	09/11/17	M	BioMEMS Fabrication	
	[05]	09/13/17	W	Introduction to Microfluidics	
4	[06]	09/18/17	M	PDMS-Based Integrated Fluidic Circuits	
	[07]	09/20/17	W	Pressure-driven Microfluidics	
5	[08]	09/25/17	M	Electric Circuits and Microfluidic Circuits	1,2,3 (5 min)
	[09]	09/27/17	W	Capillary-driven Microfluidics	4,5,6
6	[10]	10/02/17	M	Electrokinetic-driven Microfluidics	7,8,9
	[11]	10/04/17	W	Droplet-based Microfluidics	10,11,12
7	[12]	10/09/17	M	Electrowetting-based Microfluidics	13,14,15
	[13]	10/11/17	W	Centrifugal-driven Microfluidics	16,17,18
8	[14]	10/16/17	M	Ultrasonic-based Microfluidics	19,20,21
	[15]	10/18/17	W	Microfluidics Components	22,23,24
9	[16]/[17]	10/23/17	M	Microvalve/Micropump	25,26,27
	[18]	10/25/17	W	Miniaturization in Life Sciences	28,29,30
10	[19]/[20]	10/30/17	M	Particle Manipulation/Cell Manipulation/Treatm	31,32,33
	[21]	11/01/17	W	Cell Lysis/Analysis	34,35,36
11	[22]	11/06/17	M	MicroPCR	37,38,39
	[23]/[24]	11/08/17	W	Drug delivery/Implantation devices	40,41,42
12	[25]	11/13/17	M	Point-of-Care Test (POCT)	
		11/15/17	W		1,2,3,4,5,6,7 (9 min)
13		11/20/17	M		8,9,10,11,12,13,14
		11/22/17	W	No Class (Fall Recess & Thanksgiving)	
14		11/27/17	M		15,16,17,18,19,20,21
		11/29/17	W		22,23,24,25,26,27,28
15		12/04/17	M		29,30,31,32,33,34,35
		12/06/17	W		36,37,38,39,40,41,42
16	Final	12/13/17	W	Final (Norton 213) (11:45 AM - 2:00 PM)	

FROM THE DEAN about PROFESSIONALISM

Dear Faculty,

There is a great deal of excitement in the air as we prepare for the start of the Fall 2013 semester, and some slight apprehension too as we prepare to teach the one of the largest ever cohorts of students at UB SEAS! I am deeply appreciative of all the effort that has been invested during these past months to ensure that all of our students will experience the great education that is the hallmark of a UB Engineering degree.

I am writing to request your help with a focused effort to enhance the education of our students in various aspects of **professionalism**, and to elevate the standards of behavior we expect of the students. The goals here are two-fold, to improve the working and learning environment within SEAS, and to best equip our students for employment after graduation. Attached are two slides that introduce this effort.

As a part of this effort, I am attaching a suggestion, drafted by faculty, for how 'professionalism' might be incorporated into curriculum descriptions for individual course offerings. In particular, a 'professionalism' component might be graded instead of the familiar 'participation' component, where it makes sense. Please consider if this makes approach could be applied in your courses.

More specific directions might also be appropriate also for your course curriculum. For example;

- "Students are expected to use professional style in all communications, including email, with course faculty and teaching assistants. This includes the use of salutations and closings (including clear identification of the author) and correct grammar."

or

- "Students are expected to refrain from use of cell phones or other electronic devices unless they are clearly linked to class purposes (e.g., note-taking). Cell phones must remain off or muted."

This is, of course, just a one small component in this effort. The next step will be to formulate a comprehensive plan to incorporate various elements of professionalism training into our curriculum for all students. Over the coming months, I will be seeking your input on that larger plan, but I thank you in advance for considering ways in which we can engage our students now, to guide them towards enhanced professionalism through your courses.

Regards, Liesl

Liesl Folks, PhD, MBA

Dean, School of Engineering and Applied Sciences

University at Buffalo – SUNY

208 Davis Hall

Buffalo NY 14260

lfolks@buffalo.edu

Ph: 716 645 2771

Professionalism as a Graded Component in Engineering Courses

As part of a larger effort to promote a culture of professionalism among students in engineering, faculty are encouraged to include “Professionalism” as a graded component in their classes. It is not uncommon for faculty to assign a portion of the course final grade to a component called “Participation”. It usually is a small component (maybe 5%) and usually is done to encourage students to participate by attending class, asking questions, or answering questions posed by the instructor. Some instructors may take attendance or assess this in some manner; other instructors may not assess it at all and award the minor credit to everyone.

“Professionalism” can serve as a more specifically defined version of “Participation” and can replace it where used.

The professional component could include participation elements such as those listed above, perhaps emphasizing more pointedly the productive value of input a student offers to class discussion. It could also include professional behaviors such as not texting during class, looking at lap tops when they are not needed for the class, and not talking with fellow students during class. It might include other aspects of professional behavior such as properly written emails, preparedness when attending office hours, and advanced notification for classes that are missed. A suggested weighting for Professionalism in the final course grade is 5%.

Wrapping **professionalism** into and around SEAS curriculum

Professionalism: how engineers practice and conduct themselves in their work and as individuals in society.

Objective: In order to improve the working and learning environment within SEAS, and to best equip our students for employment after graduation, we should;

1. aim to educate students on a range of ‘professionalism’ topics, and
2. hold students accountable for professional behaviors.

Professionalism encompasses a broad range of topics;

- Some topics are large, and some small (i.e., quick message delivery is possible)
- Some topics will need to be visited multiple times in our degree programs
- Some topics will require external expertise / engagement
- Many topics are ‘fuzzy’, with no single correct answer or approach
- All topics will require us all to utilize teachable moments, as they occur ...

Teachable Moments: using everyday experiences to instill professionalism and to grow our students’ ability to successfully navigate the world around them.

University at Buffalo - School of Engineering and Applied Sciences

Wrapping **professionalism** into and around our curriculum, cont.

A starter list of topics in professionalism (not comprehensive, not ordered) is;

- | | |
|--|--|
| 1. Diversity and Equity training | 11. Interview techniques |
| 2. Ethics | 12. Resume writing |
| 3. Health & Safety | 13. Negotiation skills |
| 4. Intellectual property law | 14. Global economics / trade |
| 5. Managing a social media presence | 15. Working with mentors |
| 6. Communications | 16. Working in multicultural teams |
| • Written | 17. Skills to enable life-long learning |
| • Verbal | 18. Managing conflict in teams |
| • Technical writing | 19. Managing meetings effectively |
| 7. Presentation skills | 20. Project management / calendaring tools |
| 8. Visual representations of data | 21. Attentive listening skills |
| 9. Appropriate grooming | 22. Business finance basics |
| 10. How to address people in the workplace | |

Each topic should ideally be introduced into the curriculum somewhere in a structured manner, yet to be determined, but also reinforced throughout our organization, by faculty, staff, TAs, etc.

For example, faculty might deploy calendaring tools (e.g. with Google Calendar) to assist students to remain organized. With this small action, we would also be preparing students for future employment.

University at Buffalo - School of Engineering and Applied Sciences

#	Date	Time	First Name	Last Name	E-mail: E-mail@Buffalo.edu	(1) (40%) (0 - 10.0) <u>Uniqueness and originality</u> Is the proposed idea unique and original? Did he/she propose it for the first time? Is it really useful in some applications?	(2) (30%) (0 -10.0) <u>Realistic and detailed approach</u> Are there enough discussions on challenges and solutions to be able to make/fabricate it?	(3) (30%) (0 - 10.0) <u>Presentation skills</u> Does he/she entertain, inform, persuade, or sell the proposed idea effectively?	Your Signature (Attendance)
1	09/25/M	13:30	Zihe	Yang	ziheyang				
2		13:35	Zhuowei	Chen	zhuoweic				
3		13:40	Zhi Ming	Li	zhimingl				
4	09/27/W	13:30	Yuqing	Zhu	yzhu27				
5		13:35	Yizheng	Li	yizhengl				
6		13:40	Yinqi	Luo	yinqiluo				
7	10/02/M	13:30	Yilun	Zhang	yzhang93				
8		13:35	Vyshaknijagu	Stanika	vyshakni				
9		13:40	Tyler	Wong	tcwong				
10	10/04/W	13:30	Trevor	McDonough	trmcddono				
11		13:35	Suman	Narayana	sumannar				
12		13:40	Sinjini	Banerjee	sinjinib				
13	10/09/M	13:30	Sinan	Altamimi	sinanjan				
14		13:35	Siddarth	Seetharaman	sseethar				
15		13:40	Sharath Jaga	Srivatsav	ssrivats				
16	10/11/W	13:30	Ryan	Rosario	ryanrosa				
17		13:35	ruoqi	wang	ruoqiwan				
18		13:40	Ruobing	Hua	ruobingh				
19	10/16/M	13:30	Ripudaman	Dixit	rdixit				
20		13:35	Rhea Pearl	Fernandes	rheapear				
21		13:40	Poornima	Ramaraj	pramaraj				
22	10/18/W	13:30	Ping	Liu	pliu4				
23		13:35	Neerja Shiva	Sonawane	neerjash				
24		13:40	Marvin	Morris	marvinmo				
25	10/23/M	13:30	Luhui	Xu	luhuixu				
26		13:35	Kanika	Shetty	kshetty				
27		13:40	Huangyu	Fang	huangyuf				
28	10/25/W	13:30	Hemendra N	Jaiswal	hemendra				
29		13:35	Haoru	Xie	haoruxie				
30		13:40	Haiming	Li	haimingl				
31	10/30/M	13:30	Gen	Lei	genlei				
32		13:35	Dhananjay	Mishra	dmishra2				
33		13:40	Daniel	O'Shea	doshea2				
34	11/021W	13:30	Christopher	Daucher	cjdauche				
35		13:35	Chaoying	Chen	cchen54				
36		13:40	Brett	Bosinski	brettbos				
37	11/06/M	13:30	Biyao	Ren	biyaoren				
38		13:35	Avnish	Shetty	avnishsh				
39		13:40	Anwasha	Palit	anweshap				
40	11/08/W	13:30	Anuja Rajeev	Chitre	anujaraj				
41		13:35	Anthony	Hart	aphart				
42		13:40	Anish	Madurai Narayana	anishmad				

#	Date	Time	First Name	Last Name	E-mail: E-mail@Buffalo.edu	(1) (40%) (0 - 10.0) <u>Uniqueness and originality</u> Is the proposed idea unique and original? Did he/she propose it for the first time? Is it really useful in some applications?	(2) (30%) (0 -10.0) <u>Realistic and detailed approach</u> Are there enough discussions on challenges and solutions to be able to make/fabricate it?	(3) (30%) (0 - 10.0) <u>Presentation skills</u> Does he/she entertain, inform, persuade, or sell the proposed idea effectively?	Your Signature (Attendency)
1	11/15/W	12:30	Zihe	Yang	ziheyang				
2		12:40	Zhuowei	Chen	zhuoweic				
3		12:50	Zhi Ming	Li	zhimingl				
4		13:00	Yuqing	Zhu	yzhu27				
5		13:10	Yizheng	Li	yizhengl				
6		13:20	Yinqi	Luo	yinqiluo				
7		13:30	Yilun	Zhang	yzhang93				
8	11/20/M	12:30	Vyshaknijagu	Stanika	vysyakni				
9		12:40	Tyler	Wong	tcwong				
10		12:50	Trevor	McDonough	trmc dono				
11		13:00	Suman	Narayana	sumannar				
12		13:10	Sinjini	Banerjee	sinjinib				
13		13:20	Sinan	Altamimi	sinanjan				
14		13:30	Siddarth	Seetharaman	sseethar				
15	11/27/M	12:30	Sharath Jaga	Srivatsav	ssrivats				
16		12:40	Ryan	Rosario	ryanrosa				
17		12:50	ruoqi	wang	ruoqiwan				
18		13:00	Ruobing	Hua	ruobingh				
19		13:10	Ripudaman	Dixit	rdixit				
20		13:20	Rhea Pearl	Fernandes	rheapear				
21		13:30	Poornima	Ramaraj	pramaraj				
22	11/29/W	12:30	Ping	Liu	pliu4				
23		12:40	Neerja Shiva	Sonawane	neerjash				
24		12:50	Marvin	Morris	marvinmo				
25		13:00	Luhui	Xu	luhuixu				
26		13:10	Kanika	Shetty	kshetty				
27		13:20	Huangyu	Fang	huangyuf				
28		13:30	Hemendra N	Jaiswal	hemendra				
29	12/04/M	12:30	Haoru	Xie	haoruxie				
30		12:40	Haiming	Li	haimingl				
31		12:50	Gen	Lei	genlei				
32		13:00	Dhananjay	Mishra	dmishra2				
33		13:10	Daniel	O'Shea	doshea2				
34		13:20	Christopher	Daucher	cjdauche				
35		13:30	Chaoying	Chen	cchen54				
36	12/06/W	12:30	Brett	Bosinski	brettbos				
37		12:40	Biyao	Ren	biyaoren				
38		12:50	Avnish	Shetty	avnishsh				
39		13:00	Anwasha	Palit	anweshap				
40		13:10	Anuja Rajeev	Chitre	anujaraj				
41		13:20	Anthony	Hart	aphart				
41		13:30	Anish	Madurai Naray	anishmad				