BME 101: Introduction to Biomedical Engineering
Syllabus -Spring Semester 2021

1.   Basic Information

Instructor   Nicholas Wettels, PhD
Office: Online / DRB-156 (TA Office)
Email: wettels@usc.edu

Office Hours: Wednesday: 2:00 – 3:00pm
                       Thursday: 1:00 – 2:00pm

https://usc.zoom.us/j/5700897716?pwd=WDJBT0xuUXZ6clpHY0huUkFoRXNX
Zz09
Meeting ID: 570 089 7716
Passcode: 031242

TAs   Anshu Goyal   anshugoy@usc.edu
Arjun Aron   arjunaro@usc.edu
Divya Narayanan   divyanar@usc.edu

Office Hours: TBD

Lectures   Tu, Th: 11:00 – 12:20 (Section 29203D)
Location: Online

Labs   Tu: 2:00 – 3:50 (Section 29209R)
W: 3:30 – 5:20 (Section 29204R)
Location: Online

Discussion/hands-on sessions illustrate the use of computers in solving biomedical
problems, help review the class material, and provide hands-on experience with
electrical circuits.

Website   https://blackboard.usc.edu (follow link to BME 101)

Prerequisties None

2.   Course Goals, Program Objectives and Relationship to Program Outcomes

2.1. Course goals: The main goals of BME 101 are to help you:

- Develop problem-formulation and problem-solving skills for approaching engineering problems

- Understand the meaning of mass, charge, and momentum conservation equations

- Apply the conservation equations to solve problems in biology and medicine and to model biological and medical systems

- Appreciate the technical challenges and opportunities that biomedical engineering brings the life and medical sciences

- Develop and use simple software procedures and programs written in Excel and in MATLAB to solve biomedical engineering problems related to conservation equations

2.2. Learning Objectives and relation to BME Program Outcomes (see last page): After successfully completing this course, you should be able to:

- **Outcome 1:** Explain and illustrate how important functions of the human body (cardiac contraction, blood circulation, limb action) and of man-made medical systems (biochemical reactors) are studied using principlesof engineering and quantitative methods
- **Outcome 2:** Apply basic principles of science and engineering to model living functions and to understand the operation of man-made biomedical systems
- **Outcome 3:** Apply the engineering methodology to approach and understand a quantitative problem in medicine and biology
- **Outcome 4:** Utilize the Excel spreadsheet application and the software development environment MATLAB to solve and document numerical problems related to conservation equations
- **Outcome 5:** Function effectively as part of a team of student engineers to complete a multi-week engineering project
- **Outcome 6:** Document through written documents and oral presentations the analysis of an engineering problem or project
- **Outcome 7:** Read simple circuit diagrams and appropriately construct and analyze the associated electrical circuits

Relationship of Course to USC-BME Program Outcomes

USC-BME Outcomes → ↓ Course Outcomes	a	b	c	d	e	f	g	h	i	j	k
Outcome 1:	x										
Outcome 2:					x						x
Outcome 3:					x						x
Outcome 4:					x						x
Outcome 5:				x							
Outcome 6:							x				
Outcome 7:	x										x
All course outcomes	x			x	x		x				x

2.3. BME Program Outcomes: Students who successfully complete the Biomedical Engineering Program should have acquired:

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

Relationship of Course to ABET Student Outcomes

ABET Student Outcomes → ↓ Course Outcomes	1	2	3	4	5	6	7
Outcome 1:	x						
Outcome 2:	x						x
Outcome 3:	x						x
Outcome 4:	x						x
Outcome 5:					x		
Outcome 6:			x				
Outcome 7:	x						x
All course outcomes	x		x		x		x

2.4. ABET Student Outcomes:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors

3. an ability to communicate effectively with a range of audiences

4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives

6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

3.   **Class Format**

Before each class, we will ask you to do a pre-lecture exercise which may consist of one of the following: 1) watch part of the video presentations (about 10 to 15 minutes each time) or 2) read a few pages of the textbook. You have the option to either watch the video or do the reading. In either case, you will be asked to do at least one of the following: 1) upload a brief summary, 2) submit any questions about the material you may have, or 3) attempt to solve one of the problems one the slides. **You are not expected to fully understand the material after watching the video or doing the reading.** The expectation is that you are somewhat familiar with the material before coming to class. During lecture, I will spend about two-thirds of the time going over the video presentations and responding to questions.   The remainder of the time will be spent solving problems related to the material you will have learned through the videos and/or readings. The bulk of your learning will come from these in-class activities. For this reason, attending class every time is essential. You should always have your textbook and a calculator with you. Additional problems will be solved and presented in the form of a YouTube video. You may be asked to watch these videos and answer a few brief questions. Unless otherwise stated, submissions for pre-class exercises are due by 8am on the day of the lecture.

4.   Course Plan

The course material will be covered in the following tentative order:

Week 1:   Introductions
Week 2:   Engineering calculations and methodology for solving engineering problems

Week 3:   Conservation principles: extensive/intensive properties, cons./acct. equations

Week 4:   Conservation principles: system description

Week 5:   Conservation of mass: basic mass concepts, basis of calcuation

Week 6:   Conservation of mass: open, steady-state non-reacting systems.

Week 7:   Conservation of mass: multi-component systems

Week 8:   Conservation of mass: reacting systems

Week 9:   Conservation of charge: basic charge concepts, conservation and accounting
             equations applied to charge

Week 10:   Conservation of charge: simple circuits, KVL, KCL, series and parallel resistors

Week 11:   Conservation of charge: complex circuits

Week 12:   Conservation of charge: living systems, Hodgkin-Huxley

Week 13:   Conservation of momentum: basic momentum concepts, conservation and
             accounting equations applied to momentum, vectors

Week 14:   Conservation of momentum: rigid body statics

Week 15:   Conservation of momentum: rigid body statics, Summary/Conclusions

5.   Teaching Assistants

Anshu Goyal will be our graduate TA this semester. He will be in charge of running and grading laboratories. Will will also have 2 undergraduate TAs: Arjun Aron and Divya Narayanan. They will be in charge of assisting with labs and grading homework and quizzes. Give them a warm welcome!

6.   Required Source Material

Textbook: Bioengineering Fundamentals, by Ann Saterbak, Larry V. McIntire and Ka-Yiu San. Pearson Prentice Hall, 2018. ISBN-10: 0-13-463743-7

7.   Lab/Discussion Sessions

The lab section is meant to provide you with additional exposure to the concepts being covered in class. Some lab sessions will be used for lectures due to the modified 13-week semester. Some of the lab sessions will be used to introduce the use of computers for solving biomedical problems, in particular conservation problems. In these hands-on sessions, you will begin to learn MATLAB, which will be helpful when you work with MATLAB again in more advanced engineering courses

and possibly if/when you do research. There will also be several hands-on sessions in which you will put together simple electrical circuits as part of working with an Arduino.

Tentative schedule of lab sessions:

Week 1 (Jan. 19, 20): Lecture

Week 2 (Jan. 26, 27): Lab 1- Excel activity

Week 3 (Feb. 2, 3): Lab 2- MATLAB calculations and scripts

Week 4 (Feb. 9, 10): Lab 3- MATLAB vectors and plotting

Week 5 (Feb. 16, 17): Lab 4- MATLAB matrices

Week 6 (Mar. 2, 3): Lab 5- MATLAB - modeling the spread of disease

Week 7 (Feb. 23, 24): Lab 6- MATLAB functions

Week 8 (Mar. 9,10): Ultrasound imaging and therapy demo (Prof. Yen)

Week 9 (Mar. 16, 17): FDA basics for BMEs (Prof. Wettels)

Week 10/11 (Mar. 24, 30): Lab 7- Arduino activity – buttons, photo resistors, and piezo buzzers

Week 11/12 (Mar. 31, Apr. 6): Lab 8- Arduino activity 2 – temperature and flex sensors

Week 13 (Apr. 13, 14): Lab 9- **Arduino heart rate monitor**

Week 14 (Apr. 20, 21): Lab 10- Circuits and measurement lab

Week 15 (Apr. 27, 28): Lab 11- Arduino Tensile Tester – done as a demo (Prof. Yen)

The hands-on sessions will have reports due following their completion; the due date and time for each lab report will be one week from the day of the associated activity, at the start time of your next lab session. You will submit your lab reports via an online submission link on Blackboard.

For these hands-on sessions you will work in groups of two to four students. You are encouraged to discuss approaches, debugging issues, etc. However, you are responsible for writing your own code and for preparing your own report. Do not copy from each other; we expect you to learn the basics of coding by doing it yourself. **Labs listed in bold are new for this academic year and were developed to help you understand how BMEs might tackle a few aspects of the COVID pandemic.** Note that there are no labs on Tuesday Mar. 23 and Wednesday April 7 due to Wellness days. Lab assignments normally due on these days will be due one week later.

8.   <u>Assessment</u>

Learners are assessed based on their grades in quizzes, a midterm, one final exam, homework assignments, reports for the hands-on sessions, and one group project (group grade). The following schedule and percentages are used:

Assessment procedure	Date	Proportion
Quizzes	Every 3 to 4 class periods	20 %
Midterm	March 15, 2021	15-20 %
In-class Final	May 11, 2021 8-10am (Tuesday)	20-25 %
Group Project	Near the end of the semester	10 %
Pre-lecture submissions	Throughout the semester	3 %
Homework	Announced in class/via email	15 %
Hands-on session reports	1 week after session	10 %
In-class participation	Throughout the semester	2%

8.1.   Examinations: The quizzes, midterm and the final exam are closed-book tests for which you only need a calculator and a pen/pencil. The final covers the course material seen during the entire semester (that is, it is a cumulative test). All exams use multiple-choice questions and occasionally short answers problems. Quizzes cannot be made up at a later time, but we will drop the lowest two score assuming 6 quizzes are given. If 5 quizzes are given, we will drop your lowest score only. If you cannot attend the midterm or final because of illness or an emergency, you should <u>notify your instructor by email before the test.</u>

8.2.   Group Project and Presentation: The group project requires that you investigate the operation of a living system, a medical device, or a technology related to biomedical engineering. For this project, your group (3-4 students) will prepare a presentation and paper that summarizes your research. Note that the project grade is a group grade. You are responsible for ensuring that everyone in your group does his or her fair share of the work. Group assignments will be made at random. Project presentations will be made throughout the semester. We will attempt to arrange the topics to best match with current course material as much as possible.

8.3.   Homework: the homework consists of problems and exercises that test your understanding of the material and help you prepare for the in-class exams. Homework will be assigned approximately every two to three weeks resulting in about six homework sets during the semester. A preview system discussed in class will be used to maximize the benefit you will derive by doing the homework. All written assignments will be due at the beginning of class. Your two highest homework grades will carry twice as much weight as the other four homework assignments.

<u>Units must be indicated for all numerical results. All derivations must be included with symbols before numbers are "plugged in".</u> You are practicing technical communication as an engineer while preparing your homework. Clarity is as important as the numerical answers. Failure to adhere to these requirements may result in point deductions.

8.4.   Hands-on session reports: Each hands-on session handout will contain instructions regarding the report to be turned in one week after completing that lab. Each student will put together his or her own report. Your TA will indicate whether you will submit your lab online or printed copy. **Do not copy from any other student (even your groupmates); your code must be your own and your report must be in your own words.**

If submitting online, all lab reports must be submitted as PDFs with machine-readable text. Any hand-written calculations must be scanned such that they are legible and must be included directly in this document. Any code written for a given lab must also be included in this document (via copy-and-paste). Because your submission must be viewable/readable directly on the course website, zipped files are not acceptable.

8.5. Pre-lecture submissions: To encourage consistent and engaged viewing of the pre-recorded PowerPoint videos or textbook reading, you will be asked to submit comments and questions on the videos or readings. We will randomly check throughout the semester if you submitted your notes. Credit/No credit will be based on a "good faith" effort. Your comments and questions must be submitted online by the stated deadline.

Students should frequently check the grades posted on the Blackboard website and immediately notify the instructor by email about any error or missing grade. Any request for a grade change that is made after the last day of of class (April 30, 2021) will not be considered.

8.6 In-class Participation: We may assign you to groups to work on problems in class. As we work on these problems, I may randomly call on groups to present their work to me or the TAs. Students will discuss their work to the members of the teaching team. Work will be uploaded to Blackboard to receive credit. Credit/No credit will be based on a "good faith" effort. We are not looking for a perfect solution.

8.7. Course grade: The course grade is computed based on the individual assessment grades using the indicated percentages. The letter grade is assigned on a straight scale: 90% and above leading to A, 75%-90% leading to B, 60%-75% leading to C, etc. Plusses and minuses are assigned by dividing each range into corresponding halves (A, A-) or thirds (B+, B, B-, C+, ...). Thus, it is possible for everyone to receive an A, but you **must** earn it!

8.8.   Late policy: For every day (or portion of a day) an assignment is late, half of the available points will be subtracted. Any assignment (homework, lab report, etc.) that is more than two days late will not be accepted. Example: A homework assignment is late if it is due on Friday at 5pm but is turned in at 5:30pm on that Friday. If the student would have received a grade of 93 (out of 100) had it been turned in on time, the student's grade with the penalty is a 93-50 = 43. This does not apply to the work required for Pre-Lecture Submissions or In-class Participation. Late submissions for these are an automatic zero. Examples of unacceptable excuses for late submission include but are not limited to: no/poor Wi-Fi connection, submission of work to the wrong Blackboard link, forgetting to hit the submit button, and confusion about due dates.

8.9 Online submission of work. Online submission of homework assignments, labs, in-class participation, and other work will be done through Blackboard. Submissions **must** be done in PDF format (not Word, GIF, JPEG, PNG, etc.). Work that contains several pages must be submitted as one PDF, not multiple PDFs. Penalties may be applied for incorrect format. It is strongly suggested you download and use the CamScanner app to take photos of your work. CamScanner has an option to convert to PDF. For better contrast, use the "Magic Color" option. Prepare all hand-written work on one side – do not use both sides as the writing tends to bleed through. You can then upload to Blackboard. Scannable is another app. Consult with me or the TA if you are having difficulty with using the scanner apps, conversion to PDF, and/or submission to Blackboard. After you have properly submitted your work to Blackboard, you will get a confirmation message with a confirmation number and a separate confirmation email from Blackboard. If, after several attempts, you do not get a confirmation, contact Blackboard support at 213-740-555.

Keep a record of these confirmations in case there is an issue regarding late or missing submissions.

8.10 Taking quizzes and exams online: Quizzes, Midterm, and Final exam are closed book, closed notes just as they would be in class. Quizzes will be available on Blackboard 5 minutes before the class begins. Quizzes will be available in two file formats: Microsoft Word and PDF.Quizzes and Final exam will be posted in a new folder: Assignments -> Quizzes and Exams. It is estimated that you will need 5 minutes to download and print the quiz. An academic integrity statement will be added to the quiz and final exam. You will be required to sign this statement. Furthermore, you are asked to turn on your webcam or phone camera so that we can proctor the quiz/exam virtually. If you need clarification, you can use the chat function on Zoom. Be sure to use the "Private" option so that only I (or the TAs) see your question.

Take the quiz from for the stated time limit. You are expected to adhere to the stated time limit. Either the TAs or I will post a timer and share our screen. If you start a little late because of a download/printer issue you will still be allowed the stated time limit to complete the quiz, but you will have less time to upload. You will be given ~10 minutes to scan all pages, convert to PDF, and upload your work to Blackboard. Be sure your single PDF file contains all pages. Check to be sure that you receive a Blackboard confirmation via email. Keep this confirmation for your records. If you have issues with Blackboard, email me or the TAs your completed quiz/exam as a last resort. This is not the preferred method and should not be done on a regular basis. A checklist will be posted on Blackboard. You may print this checklist ahead of time and use it as a guide to ensure you have followed all necessary steps.

Alternatives: An acceptable alternative is to download the quiz so you can view it. Complete your quiz/exam on blank paper. Scan and upload your work to Blackboard. Another acceptable alternative is to complete the quiz/exam on your laptop, tablet, etc. and bypass the print/scan process altogether. Any time saved by not having to print/scan does not equate to more time to complete the quiz/exam.

9. Policy against cheating

Plagiarism – presenting someone else's ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in SCampus in Part B, Section 11, "Behavior Violating University Standards" policy.usc.edu/scampus-part-b. Other forms of academic dishonesty are equally

unacceptable. See additional information in SCampus and university policies on scientific misconduct, policy.usc.edu/scientific-misconduct.

Cheating includes (but is not limited to): looking at a neighbor's answer sheet during an in-class exam, copying the solution to an assignment (including the mistakes), using or contributing to exam question banks, handing out your solution to a classmate, modifying a graded assignment before asking for re-grading, and letting group members prepare a group assignment without participating in the effort and expecting a grade for their work.

The policy regarding cheating for this class is the following: students found cheating on a homework assignment or hands-on session report will receive a zero for that assignment. Repeated homework cheating or any cheating on quizzes, exams or the project will result in the student being reported to the Office of Student Judicial Affairs and Community Standards where additional disciplinary measures could be taken. Review the policies and processes of that office at http://www.usc.edu/student-affairs/SJACS/index.html.

This policy does not apply to discussion, exchange of information, working together, etc. On the contrary, we encourage that you consult with classmates regarding learning material and homework assignments. Group projects require that you work with your group and assist your group members as much as they assist you. However, for individual marks, it is required that you prepare the final product by yourself and to the best of your abilities; for group marks, it is required that you bring to the group as much as you take.

10.   **Resources**

10.1.   Courseware and email: the course management software "Blackboard" will be used in this class (https://blackboard.usc.edu). "Blackboard" has a number of features to promote interactions between students and with the teaching team. You are encouraged to use these communication tools as much as possible. In particular, questions regarding the course content or the homework should be sent by email using "Blackboard" to the whole class rather than only to the teaching team. This will give everyone in the class the opportunity to answer. Of course, personal matters can be discussed by private email, phone or in person.

10.2.   TA/Office Hours: The instructor and teaching assistant hold office hours every week. This is for your benefit and you should feel welcome to the office hours as much as you need assistance.

10.3.   Disability Statement: Students requesting academic accommodations based on a disability are required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP when adequate documentation is filed. Please be sure the letter is delivered to me within the first few weeks of the semester. DSP is open Monday-Friday, 8:30 AM to 5:00 PM. The office is in Grace Ford Salvatori Hall in room 120 and the phone number is (213) 740-0776.

11.   **Social Conduct**

Discrimination, sexual assault, and harassment are not tolerated by the university. You are encouraged to report any incidents to the *Office of Equity and Diversity* http://equity.usc.edu

or to the *Department of Public Safety* http://capsnet.usc.edu/department/department-public-safety/online-forms/contact-us. This is important for the safety of the whole USC community. Another member of the university community – such as a friend, classmate, advisor, or faculty member – can help initiate the report, or can initiate the report on behalf of another person. *The Center for Women and Men* http://www.usc.edu/student-affairs/cwm/ provides 24/7 confidential support, and the sexual assault resource center webpage http://sarc.usc.edu describes reporting options and other resources.

12.   Other Support Systems

Counseling and Mental Health - (213) 740-9355 – 24/7 on call

studenthealth.usc.edu/counseling

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

National Suicide Prevention Lifeline - 1 (800) 273-8255 – 24/7 on call

suicidepreventionlifeline.org

Free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week.

Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-9355(WELL), press "0" after hours – 24/7 on call

studenthealth.usc.edu/sexual-assault

Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

Office of Equity and Diversity (OED) - (213) 740-5086 | Title IX – (213) 821-8298

equity.usc.edu, titleix.usc.edu

Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants.

Reporting Incidents of Bias or Harassment - (213) 740-5086 or (213) 821-8298

usc-advocate.symplicity.com/care_report

Avenue to report incidents of bias, hate crimes, and microaggressions to the Office of Equity and Diversity |Title IX for appropriate investigation, supportive measures, and response.

The Office of Disability Services and Programs - (213) 740-0776

[dsp.usc.edu](dsp.usc.edu)

Support and accommodations for students with disabilities. Services include assistance in providing readers/notetakers/interpreters, special accommodations for test taking needs, assistance with architectural barriers, assistive technology, and support for individual needs.

USC Campus Support and Intervention - (213) 821-4710

campussupport.usc.edu

Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

Diversity at USC - (213) 740-2101

diversity.usc.edu

Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

USC Emergency - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call

dps.usc.edu, emergency.usc.edu

Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

USC Department of Public Safety - UPC: (213) 740-6000, HSC: (323) 442-120 – 24/7 on call

dps.usc.edu

Non-emergency assistance or information.

Office of the Ombuds - (213) 821-9556 (UPC) / (323-442-0382 (HSC)

ombuds.usc.edu

A safe and confidential place to share your USC-related issues with a University Ombuds who will work with you to explore options or paths to manage your concern.

13.   **Professor's Bio**

Nicholas Wettels received his PhD in biomedical engineering from the University of Southern California in 2011. His dissertation titled, "Biomimetic Tactile Sensor for Grip Control and Object Identification" focused on endowing prosthetic hands with human-like sensing capability. His research was funded by a NASA GSRP Fellowship while interning on the Robonaut 2 project at Johnson Space Center.

In 2008, he co-founded the start-up company SynTouch to commercialize touch sensors for robotic and prosthetic hands and acted as its Chief Operating Officer for 4 years. Following SynTouch, Nicholas completed post-doctoral research studies at the NASA Jet Propulsion Laboratory writing navigation software and designing grippers for a gecko-inspired space robot for the International Space Station. He then founded Perception Robotics as CEO which was acquired by OnRobot in 2018 to form the one-stop-shop for collaborative robotic end-of-arm-tooling. Nicholas is now the R&D Director at OnRobot Los Angeles. His vision is to endow manufacturing robots with the same reach-and-grasp and touch sensing capabilities as humans. In addition to managing, Nicholas also writes firmware for the grippers and well as scientific computing and machine learning scripts.

Nicholas is a Commander in the US Navy, serving 6 ½ years active and 13 years reserve duty as a submarine officer. Commander Wettels is a 2000 graduate of Tulane University, where he received a Bachelor of Science degree in Physics and commission through the NROTC program. After graduation he conducted naval nuclear power training in Charleston, SC, followed by submarine officer training in Groton, CT.

Nicholas' active duty tours include USS Topeka (SSN 754) and Navy Recruiting District – Los Angeles where he was Engineering and Chaplain Programs Officer for 9 Southern California counties. His reserve career includes department head duty at two theater anti-submarine units supporting various 7th fleet theater exercises. He has also served in Office of Naval Research and Space and Naval Warfare Systems Command as the deputy for autonomous systems. His personal military awards include three Navy and Marine Corps Commendation Medals and three Navy and Marine Corps Achievement Medals.

Nicholas also has an MS in Engineering Management from Old Dominion University (2005), an MS from USC in Biomedical Engineering (2008) and is a graduate of the US Naval War College's Joint Professional Military Education Program (2015).