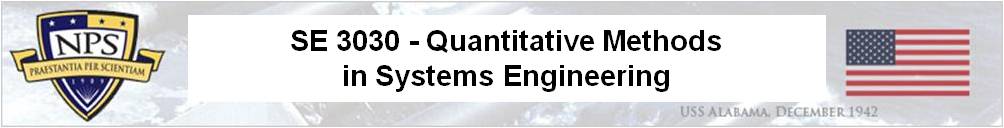
**SE3030 Quantitative Methods in Systems Engineering**

This syllabusis your course guide. It contains the following sections:

## Course instructor

## Course goal

## Course description

## Learning objectives

## Course format

## Expectations

## Weekly Topics

## Prerequisites

## Technical requirements

## Textbooks

## References

## Evaluation

## Participation criteria

## Late policy

## NPS Honor Code

**1.0 Instructor**

## Douglas H. Nelson, [dhnelson@nps.edu](mailto:dhnelson@nps.edu)

Office phone: 831.656.7572

**2.0 Goal**

After completing this course, you will be able to apply the quantitative methods in systems engineering including advanced mathematical methods and numerical computing.

**3.0 Course Description**

This course discusses advanced mathematical and computational techniques that find common application in systems engineering. It also provides an introduction to MATLAB, a computational tool useful in obtaining quantitative answers to engineering problems. Among the topics addressed in this course are vector analysis, complex analysis, integral transforms, special functions, numerical solution of differential equations and numerical analysis.

**4.0 Learning Outcomes**

Upon successful completion of this course, you should be able to:

* Apply knowledge of ordinary differential equations including operating with Laplace transforms, series solutions, special functions along with the special case of decay functions;
* Demonstrate understanding of linear algebra and vector calculus as well as the associated matrix algebra, multiple integrals, vector analysis and curvilinear coordinates
* Use the tools of partial differential equations and Fourier analysis, Fourier series & transforms, including application to the cases of wave & diffusion equations;
* Employ complex analysis & potential theory through the use of infinite & power series, complex numbers, functions of a complex variable, contour integration and optimization;
* Recognize engineering applications of the various numerical methods including use of interpolation, equation solving, numerical integration, finite difference techniques and curve fitting;
* Demonstrate understanding of probability & statistics including probability distributions, regression techniques as well as queuing theory;
* Employ calculus of variations, perturbation theory, tensor analysis, groups & group representations, Boolean algebra & logic as well as eigenvalue problems & Green’s functions.
* Use MATLAB proficiently for scientific and engineering applications including writing script and function files, 2-D and 3-D plotting, programming (flow control), and producing meaningful and readable solutions (reports).

**5.0 Course Format**

**This course is divided into weeklong segments consisting of:**

* **Online modules.** The material for the course has been organized into weekly self-contained modules. Each module will list required reading and assignments. This course will be supplemented by use of asynchronous technology for support. It is expected that you will use our commercial web-based distributed-learning support tool Sakai (accessed via https://cle.nps.edu).
* **Lectures.** Your instructor will host weekly lectures. Students will present the topics. The lectures are mandatory but the session will be recorded so the students can watch at a later time via Elluminate. If you need some help with Elluminate, there is some helpful information at [www.nps.edu/Technology/Elluminate/index.html](http://www.nps.edu/Technology/Elluminate/index.html). In addition, as detailed below, each of you will be presenting your share of course topics during the Elluminate sessions.
* **Discussion forums.** These forums are in Sakai. They provide the opportunity to collaborate with colleagues to discuss various aspects of quantitative methods in systems engineering, including coordinating for your topic presentations.
* **Lab sessions.** The course is a 3/2 hour course. This means there are 3 hours of lecture in class and 2 hours of lab out of class. This portion of the class is not scheduled but is where you learn and practice working with the methods and techniques of systems engineering on a real system. You will have MATLAB aspects of your assignments and graded submissions. Matlab is available on the NPS Software Download Library. Please access the link below for instructions how to install Matlab on your desktop/laptop.

[***https://www.nps.edu/Technology/SoftwareLib/Auth/index.htm***](https://www.nps.edu/Technology/SoftwareLib/Auth/index.htm)

**6.0 Expectations**

The expectation is that you will be active, skilled participants in course learning. Participation in class discussions is a key to success, especially with regard to developing critical thinking skills. Passively observing your classmates or instructor will lead to poor performance – interaction is the key because it’s not just “info download!” Your efforts should demonstrate a mind taking charge of its own ideas, assumptions, inferences, and intellectual processes. You are responsible for all material covered in class. In general, it is preferable to use direct email to me as a means of communication for direct questions that may have little relevance for the rest of the class. For issues that may be of relevance to the rest of the class, I have established an on-line discussion board forum called “Questions” in the Discussion Forums area of Sakai.

The lecture in each module represents 2-3 hours of class time, the reading usually requires 2-3 hours, and the assignments and other activities can take up to 6 hours. That’s 10-12 hours per week. Your weekly work flow should be: open the module for the week > read the required material (textbooks or other hand-outs) > participate in the lecture > do the assignments. It is expected that you will do your own work and submit only your own work for examinations and homework (team work allowed on HW), unless otherwise indicated for a specific item.

From me, you should expect fair treatment and application of the policies outlined in this syllabus; an opportunity to actively interact with me and your classmates every class meeting; and demonstration of engineering reasoning and intellectual humility. Also, I will try to provide something new of immediate practical utility every week.

**Office Hours**. I will not have a specific office hour time. I am available most days from 0800 to 1600 Pacific Time. I do teach other classes but check my email often. Sometimes I’ll be on travel but can usually get email just about anywhere.

**7.0 Weekly Topics**

Assignments and activities will be given each week. Time required to complete course readings and assignments is generally **4-6 hours per week,** this does not include the 2 hour weekly lab sessions that will be conducted individually to support learning MATLAB. The Schedule Matrix is provided separately on Sakai.

To accommodate the needs of individual participants through a distributed learning model, this course is primarily an online experience using significant synchronous and asynchronous delivery and interaction methods.

It is essential that you have the **minimum amount of time** to devote to this course and that you are **available** to attend or view the required sessions. This is a “student-centered” and group-paced course that requires your attendance, timely participation, peer review and feedback.

**We learn from each other in this model, it's not just an "info download!"**

**8.0 Prerequisites:** SE1002 and OS3180.

**9.0 Technical Requirements**

A working knowledge and proficiency with basic computing and office automation is required. This is defined asthe ability to:

* organize and manage files and folders in your operating system;
* receive and submit electronic course materials;
* effectively use (create, format, edit, save, and distribute documents) a word processing program, typically using MS Word or compatible format;
* send and receive e-mail (including attachments); and,
* navigate, search, download, and execute files from the Internet.

**Recommended technical specifications**: You will be able to access the course materials using your campus or home computer as long as you are able to connect to the Internet.

**It is recommended that you have a PC** with a minimum of 128 Megabytes of system memory (RAM). It is also recommended that you have a microphone to use for the Elluminate sessions. Chatting is available, but a microphone will enable the student to ask questions and provide input in real time.

NPS recommends using **Internet Explorer** as your Web browser to access the online portions of the course delivered through the Sakai learning support system. If you prefer to use other Web browsers, see the recommendations for versions located in the Syllabus section of the Sakai site.

Some materials may be provided in Adobe portable document format (PDF) that will require you to have a free “Acrobat Reader” on your computer (available for download at http://www.adobe.com/acrobat). Interactive components in the online modules require the Flash player.

If you have software issues or need instruction to meet the prerequisite technical experience, contact Information Technology & Academic Computing Support (ITACS) Technology Assistance Center (TAC) for assistance.

Email: TAC@nps.edu

Telephone: (831) 656-1046

Location: Ingersoll Hall, Room 151

Hours: Monday - Friday, 8:00 a.m. to 4:30 p.m.

Training Services: http://www.nps.edu/Technology/Navigation/TrainingSrv.html

**10.0 Textbooks**

**Mathematical Methods in the Physical Sciences,** Boas, Mary, Wiley, 3rd Edition, 978-0-471-19826-0, 2006.

**Systems Engineering and Analysis,** Blanchard, B. S. and , W. J. Fabrycky, Prentice-Hall International Series in Industrial and Systems, 5th Edition, ISBN 978-0-13-221735-4, 2010

**11.0 References**

Excerpts from these and other references will be provided in Sakai:

**International Council on Systems Engineering (INCOSE) SE Handbook,** Version 3.2 Feb 2010, INCOSE

**Defense Acquisition Guidebook**

**12.0 Evaluation**

The evaluation scheme of this course is outlined in the following table.

|  |  |
| --- | --- |
| **Requirements** | **%** |
| Exam 1 | 30 |
| Exam 2 | 30 |
| Homework | 20 |
| Class Topic Presentation | 20 |

Table 1 Course Evaluation

***Homework***

Students will be allowed to submit in groups. These allow you to demonstrate mastery of the subject matter. These will be submitted in pdf format on Sakai. The homework assignments are detailed below. All are from Boas except those beginning with “B&F” (Blanchard & Fabrycky). Also, the underlined problems require computer use, you will provide the MATLAB .m file in addition to the finished plot, etc.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| HOMEWORK | | | | | | | | | | |
| I | II | III | IV | V | VI | VII | VIII | IX | X | XI |
|
| 1.1.16 | 2.9.18 | 3.6.1 | 6.3.2 | 7.2.9 | 8.2.5 | 9.2.3 | 12.1.3 | 12.11.2 | 14.1.9 | 15.7.7 |
| 1.6.27 | 2.10.28 | 4.1.12 | 6.4.3 | 7.4.2 | 8.3.4 | 10.5.6 | 12.2.3 | 12.12.2 | 14.2.9 | 15.8.6 |
| 1.10.2 | 2.11.11 | 4.5.6 | 6.6.5 | 7.5.3 | 8.4.3 | 11.3.12 | 12.4.3 | 12.14.1 | 14.2.22 | 15.10.4 |
| 2.4.12 | 2.12.29 | 4.7.3 | 6.7.5 | 7.6.3 | 8.5.12 | 11.5.1 | 12.5.8 | 13.1.3 | 14.3.3(b) | B&F 10.16 |
| 2.5.5 | 2.14.17 | 5.2.1 | 6.8.16 | 7.7.3 | 8.5.33 | 11.7.6 | 12.6.2 | 13.4.1 | 14.4.7 |  |
| 2.5.41 | 3.2.3 | 5.3.6 | 6.9.12 | 7.12.5 | 8.6.19 | 11.9.1 | 12.8.1 | 13.5.1(a) | 14.6.22 |  |
| 2.5.59 | 3.3.4 | 5.5.13 | 6.11.7 | B&F 9.1 | 8.9.5 | 11.12.4 | 12.9.2 | 13.7.4 | 14.7.4 |  |
|  |  |  |  |  | 8.11.2 |  |  |  |  |  |

Table 1 Homework Assignments

***Examinations***

There will be two “take home” exams given during the course. The exams will be used as a measure of the student’s understanding and application of the concepts covered during the course. Preparation for the exams will best be accomplished by completing the readings, homework assignments and by participating in the class meetings and discussions. The exam is not intended to test the student on rote memorization, but to assess how well the concepts are understood and tied together. Waiting until just before the exam and cramming will not be effective. It will of course be open book; open notes. More details will be provided just before the exam.

***Class Presentation***

As all in the class are PhD students, you will each be expected to present at least sic of the course topics (good preparation for dissertation defense, among other things). I have provided the list of course topics with references on Sakai as a “Sign up Sheet.” You must present your topics in at least 3 different class sessions. This presentation may take any form or technique you deem appropriate. Please let me know of any example problems you plan to present at least two days prior to the class session when you will present. Note that we nominally have ~3 hours per session, so your presentation time should fit with the other topics for that day (i.e. if one of three topics, then you have ~50 minutes to present your material). At the very least, this will ensure you do not have to listen only to me for 3 hours at a time week in and week out.

The course grading criteria are:

A - 93 to 100% of the total possible points

A - - 90 to 93% of the total possible points

B+ - 87 to 90% of the total possible points

B - 83 to 87% of the total possible points

B - - 80 to 83% of the total possible points

C+ - 77 to 80% of the total possible points

C - 73 to 77% of the total possible points  
C - - 70 to 73% of the total possible points   
D - 60 to 69% of the total possible points   
F - 0 to 59% of the total possible points

**13.0 Online Participation Criteria**

Participation is a critical part of a dynamic and interactive online learning experience. In addition to completing activities, such as reading, and completing Lab exercises, you will engage with the online content and participate in asynchronous discussions with other class participants. I recommend logging on to the Sakai course site at least 3 days each week. This strategy of frequent participation in online courses is found to be most effective in improving retention and completion rates…a little every day gets the job done! It assists you in time management, and provides a structure and incentive to remain "connected" to the class.

You will get a quantitative assessment of your participation.

**14.0 Late Policy**

Homework and Exams include specific due dates to facilitate the pacing and interaction in the course. Your attention to the dates will contribute to an effective learning community and insure that you and your colleagues are able to help one another build and improve your knowledge. Points will be deducted, and at times late accomplishment will result in a zero grade, for assignments that are not submitted by the requested dates, unless **prior** arrangements have been made.

**15.0 NPS Honor Code**

[NAVAL POSTGRADUATE SCHOOL HONOR CODE (ref: NAVPGSCOLINST 5370.4B)](http://intranet.nps.edu/Code00/Instructions/pdf_files/NPSINST%205370.4B.pdf)