# OPTI 280: Computer Programming Workshop Syllabus

**Instructor**

Professor Stanley Pau, College of Optical Sciences, Meinel Optical Sciences, Room 427
Email: spau@optics.arizona.edu
Office Hours: to be announced

**Schedule**

Lecture, Monday 1:30pm to 2:45pm
Location, Education Room 349

**Teaching Assistant**

Gregory Nero, Email: gnero@email.arizona.edu
Office Hours: to be announced

**Course Objectives**

To teach students the basic concepts of computer programming and how scientific or engineering problems can be translated into working computer programs. Students will also be taught some elementary concepts of statistical analysis.

**Expected Learning Outcomes**

Upon successful completion of this course, each student should:
- be able to use MATLAB to perform complex scientific calculations, such as Fourier transform, integration, differential equation, matrix
- become familiar with rudimentary programming techniques
- be proficient with data handling and analysis, using a computer
- be able to apply numerical analysis to solve problems

**Course Description**

MATLAB is used as the vehicle for the computer programming assignments in numerical and symbolic computing. Basic concepts of computer programming and control structures will be discussed and practiced by writing and debugging computer programs that do numerical calculations and symbolic mathematics, that create graphics and figures, and that manipulate vectors and matrices.

The concepts will be illustrated with a variety of programming assignments involving examples from optics and other areas of science and engineering. Numerical techniques, including numerical differentiation and integration, solution of differential equations, data import and export, error analysis, and curve fitting, will be illustrated in the assignments.

**Grading**

no midterm or final

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| homework | 70% |
| in-class quizzes | 30% |

Each assignment is worth 100 points, is due a week after it is assigned and is to be submitted in class. Assignments that are handed in late will be penalized 15 points per week.

## Textbooks and Software

A version of MATLAB is available for downloading at https://softwarelicense.arizona.edu.

Class Notes – *Opti 280 MatLab Tutorial*, electronic copy is available on D2L

*Essential MATLAB for Engineers and Scientists, 7th Edition*, Brian H. Hahn and Daniel T. Valentine, Academic Press, 2019.

(Download link: https://ebookcentral.proquest.com/lib/UAZ/detail.action?docID=5787889)

Supplements and additional materials are available at class website, which will be updated periodically during the semester: https://d2l.arizona.edu (use your NetID to login).

## Course Outline

- Program statements, variables, operators, functions, and input/output
- Program structure, computer program debugging
- Vector variables, creating plots and graphs
- Relational operators, **if…end** structures, and **for** loops
- **Switch** structures and **while** loops
- Elementary statistical analysis and histograms
- Error propagation and statistical correlation
- Data import and export, and curve fitting
- Computer-aided symbolic algebra, integration, and differentiation
- Numerical differentiation, round-off errors and numerical precision
- Numerical integration
- Numerical solution of differential equations
- Numerical Fourier transform
- Graphics and images

## Course policies

It is ***very important*** to attend all lecture recitation sessions, as what is discussed provides the necessary background for the weekly assignment. If you must be absent, it is your responsibility to obtain and review the information you missed. Periodic quizzes will be given to help you gauge your progress in learning the material. You should expect to have about 6 quizzes this semester. There is no make-up for quiz. If you missed the quiz, you get a zero.

## Additional Information

### Academic Integrity

According to the Arizona Code of Academic Integrity (http://deanofstudents.arizona.edu/policies-and-codes/code-academic-integrity), "Integrity is expected of every student in all academic work. The guiding principle of academic integrity is that a student's submitted work must be the student's own." Unless otherwise noted by the instructor, work for all assignments in this course must be conducted independently by each student. CO-AUTHORED WORK OF ANY KIND IS UNACCEPTABLE. Misappropriation of exams before or after they are given will be considered academics misconduct.

Misconduct of any kind will be prosecuted and may result in any or all of the following:
* Reduction of grade
* Failing grade
* Referral to the Dean of Students for consideration of additional penalty, i.e. notation on a student's transcript re. academic integrity violation, etc.

### Students with Special Needs

It is the University's goal that learning experiences be as accessible as possible. If you anticipate or experience physical or academic barriers based on disability or pregnancy, please let me know immediately so that we can discuss options. You are also welcome to contact Disability Resources (520-621-3268) to establish reasonable accommodations.

### Threatening Behavior Policy

The University prohibits threats of physical harm to any member of the University community. Detail policy can be found in http://policy.arizona.edu/education-and-student-affairs/threatening-behavior-students.

### Nondiscrimination and Anti-harrassment Policy

The University is committed to creating and maintaining an environment free of discrimination. The policy is described in http://policy.arizona.edu/human-resources/nondiscrimination-and-anti-harassment-policy.

## References


[1] Class notes were originally prepared by Prof. R. L. Shoemaker.
[2] M. E. Herniter, Programming in MATLAB, Wadsworth Group, 2001.
[3] A. Gilat, MATLAB, An Introduction with Applications, 2nd Edition, John Wiley & Sons 2005.
[4] S. J. Chapman, Essentials of MATLAB Programming, Nelson, 2006.
[5] W. H. Press, B. P. Flannery, S. A. Teukolsky, W. T. Vetterling, Numerical Recipe in C, The Art of Scientific Computing, Cambridge University Press, 1988.
[6] B. H. Hahn and D. T. Valentine, Essential MATLAB for Engineers and Scientists, 7th edition, Academic Press, 2019

# Computer Programming Workshop
# OPTI 280, Spring 2022

**Week 1:** **17 Jan. 2022**
No class, Martin Luther King Day

**Week 2:** **24 Jan. 2022**
Lecture 1: MATLAB, variables, functions, fprintf, Assignment 1

**Week 3:** **31 Jan. 2022**
Lecture 2: Vectors, Plots & Graphs, Debug, Assignment 2

**Week 4:** **7 Feb. 2022**
Lecture 3: Program control flow, IF END, FOR loops, Matrix, Assignment 3, Quiz 1

**Week 5:** **14 Feb. 2022**
Lecture 4: Program development, SWITCH, WHILE, Assignment 4

**Week 6:** **21 Feb. 2022**
Lecture 5: Matrix and Vectors, Assignment 5

**Week 7:** **28 Feb. 2022**
Lecture 6: File I/O, Basic statistics, Assignment 6, Quiz 2

**Week 8:** **7 Mar. 2022**
Spring recess – no class Mar. 5-13, 2022

**Week 9:** **14 Mar. 2022**
Lecture 7: More statistics, Probability distributions, Sorting, Assignment 7

**Week 10:** **21 Mar. 2022**
Lecture 8: Propagation of errors, Curve fitting, Assignment 8, Quiz 3

**Week 11:** **28 Mar. 2022**
Lecture 9: Symbolic math, Roots of linear & nonlinear equations, Assignment 9, Quiz 4

**Week 12:** **4 April 2022**
Lecture 10: MATLAB functions, Numerical differentiation & integration, Assignment 10

**Week 13:** **11 April 2022**
Lecture 11: Solutions of differential equations, Assignment 11, Quiz 5

**Week 14:** **18 April 2022**
Lecture 12: Fourier transform I, Assignment 12

**Week 15:** **25 April 2022**
Lecture 13: Fourier transform II, Assignment 13, Quiz 6

**Week 16:** **2 May 2022**
Lecture 14: Graphics and Images, Assignment 14 (Extra Credit), Course Evaluation

All late and extra credit homework assignment due on last day of class, Wed., May, 4