

ECE 5273

Digital Image Processing

Spring 2025

TIME: TR 4:30 – 5:45 PM

PLACE: SEC N202

INSTRUCTOR:

Dr. J. P. Havlicek

DEH 333

Office Hours: TR 2:00 – 3:00 PM and by appointment

E-mail: joebob@ou.edu

TEXT & REFERENCES:

1. “ECE 5273 *Digital Image Processing*” Lecture Notes Pack. The lecture notes will be made available on Canvas.
2. Recommended text: A. Bovik, *The Essential Guide to Image Processing*, Academic Press, Burlington, MA, 2009, ISBN 978-0-12-374457-9. This book has significant overlap with the course lecture notes. The examples are implemented in LabVIEW.
3. Recommended text: R.C. Gonzalez and R.E. Woods, *Digital Image Processing*, Prentice Hall, Upper Saddle River, NJ, 2017, ISBN 978-0-13-335672-4. Some previous editions were published by Addison-Wesley. This is a classic comprehensive text on digital image processing that is currently in its 4th edition.

COURSE WEB PAGE: <http://coecs.ou.edu/Joseph.P.Havlicek/ece5273/>

CANVAS: <http://canvas.ou.edu>

You will submit your homework assignments electronically on Canvas. Announcements and lecture notes will also be posted on Canvas.

PREREQUISITE:

ECE 3793, *Signals and Systems*, **or** elementary knowledge of the Fourier transform, the Fourier series, the discrete Fourier transform, and their use in linear system analysis.

RELIGIOUS OBSERVANCES:

It is the policy of the University to excuse absences of students that result from religious observances and to provide without penalty for the rescheduling of examinations and additional required classwork that may fall on religious holidays. It is the responsibility of the **student** to make alternate arrangements with the instructor *at least one week prior to the actual date of the religious holiday*.

UNIVERSITY POLICY ON ACADEMIC HONESTY:

<http://www.ou.edu/integrity>

This page outlines the University's expectations of academic honesty, defines misconduct, provides examples of prohibited conduct, and explains the sanctions available for those found guilty of misconduct. Additional information clarifying the precise meaning of *academic misconduct* in this course is provided below.

The UOSA Statement of Academic Integrity will be used in this course.

COURSE DESCRIPTION:

This introductory graduate-level course provides an overview of the main concepts, results, and techniques that are the foundations of current academic research and industry practice in digital image processing.

HOMEWORK:

Homework assignments will be posted on the course web site and will generally be due on Canvas at midnight on the published due date. Solutions will be posted on the course web site. *Late homework will not be accepted* (see policy below).

You are encouraged to work together on homework, but **DO NOT COPY!** Each problem solution that you turn in must be your own;

- if you copy another person's solution and turn it in as your own, then *you are guilty of academic misconduct*.
- If you copy an old homework solution without working the problem yourself and turn it in, then *you are guilty of academic misconduct*.

All computer codes and results that you submit in this course must be your own original work.

- **If** you obtain code from another person in an electronic format and incorporate it into the solution that you turn in, **then** *you are guilty of academic misconduct*.
- **If** you obtain code from another person in electronic or hardcopy formats and then type it in yourself and include it in the solution that you turn in, **then** *you are guilty of academic misconduct*.
- In certain cases, it may be acceptable to incorporate existing public domain and/or library computer algorithms and codes into a solution that you submit. In such cases, however, you must always obtain prior authorization from the instructor and you must always document the source of any algorithms and/or code that is not your own original work.

LATE HOMEWORK POLICY:

Late homework will not be accepted. There are two reasons for this policy. First, accepting a late homework assignment from one student is unfair to other students who may have stayed up all night to get the assignment done and may also have sacrificed grades in other classes to get it done. Second, it would be detrimental to the overall learning outcomes of the class to delay the posting of homework solutions in order to accommodate late assignments.

TESTS & EXAMS:

There will be two tests. There will NOT be a final exam. The Tests will be announced in class at least one week in advance. You may use calculators on the tests, but you may NOT use calculator programs.

The tests are OPEN NOTES. This means that you may access a clean copy of the course lecture notes during the tests. **Other materials are NOT allowed.** All work that you submit on your test paper must be your own; collaboration on a test constitutes a serious case of academic misconduct.

If you miss a test and your absence is NOT officially excused, then you will receive a zero grade. If you miss a test and your absence IS officially excused, then a makeup test will be given by arrangement with the instructor. Makeup tests may be written or oral at the discretion of the instructor.

TERM PROJECT:

A term project will be required of all students in the class. You will design your own term project. Written proposals for the term project will be due near the middle of the semester. The due date will be announced in class and posted on the course web site. A written progress report will also be due sometime between the proposal and the final project submission; the due date will be announced in class and posted on the course web site.

There is a required format for the written project proposal and written reports: they are required to conform to *either* the IEEE Signal Processing Society requirements for conference papers *or* the IEEE Computer Society requirements for conference papers. More information on this requirement will be given in class.

The term project must involve significant creative activity and analysis or design. Look in recent journal articles and conference proceedings for ideas (analysis, extension, and implementation of a technique described in a published paper **do** constitute creative activity).

The term project should not simultaneously be used to satisfy requirements for another class unless advance permission is obtained from the instructor.

For substantial projects, joint or group work may be acceptable, but must be approved by the instructor in advance.

The standards of academic honesty given above for homework apply to the term project as well.

Project Suggestions:

- Development of new techniques.
- Extension of existing techniques.
- Simulation and analysis of existing techniques that yields new insight.
- Application of existing techniques to real-world image processing or machine vision problems.

COMPUTER USE:

Computer use will be required for the homework assignments and term project. You may use GCoE computers or any other computers that you have access to. Use of C, C++, Python, and/or Matlab are endorsed and recommended. Other languages are also acceptable. Matlab will be required for some homework assignments. Instructions for how to install Matlab on your own computer are available on the “handouts” section of the course web site. Matlab is also available on the College of Engineering Virtual Lab (see handout on the course web site).

GRADING:

Your final numerical grade will be calculated as shown in the following table.

What	Value
Homework	25%
Test I	20%
Test II	20%
Project Proposal	5%
Project Progress Report	5%
Term Project	25%

These numerical grades will be converted into letter grades using a curve determined by the instructor. The same curve will be applied to all students in the class. The curve will *never* hurt your grade relative to the ten-point scale.

COURSE OUTLINE:

1. Course Introduction, Image Types, Imaging Geometry, Image Acquisition, Imaging Devices, Image Representation.
2. Binary Image Processing.
3. Histogram, Point Operations, Algebraic & Geometric Image Operations.
4. Digital Fourier Transform, Sampling Theorem.
5. Convolution, Linear Filtering, Linear Image Enhancement, Linear Image Restoration (Deconvolution).
6. Nonlinear Image Filtering.
7. Introduction to Digital Image Analysis.
8. Digital Image Coding and Compression.
9. Video Coding.
10. Introduction to Machine Learning.
11. Introduction to Video Object Tracking.

ADDITIONAL REQUIRED UNIVERSITY LEGAL & POLICY STATEMENTS

MENTAL HEALTH SUPPORT SERVICES:

Support is available for any student experiencing mental health issues that are impacting their academic success. Students can either be seen at the University Counseling Center (UCC) located on the second floor of Goddard Health Center or receive 24/7/365 crisis support from a licensed mental health provider through TELUS Health. To schedule an appointment or receive more information about mental health resources at OU please call the UCC at 405-325-2911 or visit University Counseling Center. The UCC is located at 620 Elm Ave., Room 201, Norman, OK 73019.

TITLE IX RESOURCES AND REPORTING REQUIREMENT:

The University of Oklahoma faculty are committed to creating a safe learning environment for all members of our community, free from gender and sex-based discrimination, including sexual harassment, domestic and dating violence, sexual assault, and stalking, in accordance with Title IX. There are resources available to those impacted, including: speaking with someone confidentially about your options, medical attention, counseling, reporting, academic support, and safety plans. If you have (or someone you know has) experienced any form of sex or gender-based discrimination or violence and wish to speak with someone confidentially, please contact OU Advocates (available 24/7 at 405-615-0013) or University Counseling Center (M-F 8 a.m. to 5 p.m. at 405-325-2911).

Because the University of Oklahoma is committed to the safety of you and other students, and because of our Title IX obligations, I, as well as other faculty, Graduate Assistants, and Teaching Assistants, are mandatory reporters. This means that we are obligated to report gender-based violence that has been disclosed to us to the Institutional Equity Office. This means that we are obligated to report gender-based violence that has been disclosed to us to the Institutional Equity Office. This includes disclosures that occur in: class discussion, writing assignments, discussion boards, emails and during Student/Office Hours. You may also choose to report directly to the Institutional Equity Office. After a report is filed, the Title IX Coordinator will reach out to provide resources, support, and information and the reported information will remain private. For more information regarding the University's Title IX Grievance procedures, reporting, or support measures, please visit Institutional Equity Office at 405-325-3546.

REASONABLE ACCOMMODATION POLICY:

The University of Oklahoma (OU) is committed to the goal of achieving equal educational opportunity and full educational participation for students with disabilities. If you have already established reasonable accommodations with the Accessibility and Disability Resource Center (ADRC), please submit your semester accommodation request through the ADRC as soon as possible and contact me privately, so that we have adequate time to arrange your approved academic accommodations.

If you have not yet established services through ADRC, but have a documented disability and require accommodations, please complete ADRC's pre-registration form to begin the registration process. ADRC facilitates the interactive process that establishes reasonable accommodations for students at OU. For more information on ADRC registration procedures,

please review their Register with the ADRC web page. You may also contact them at (405)325-3852 or adrc@ou.edu, or visit www.ou.edu/adrc for more information.

Note: disabilities may include, but are not limited to, mental health, chronic health, physical, vision, hearing, learning and attention disabilities, pregnancy-related. ADRC can also support students experiencing temporary medical conditions.

RELIGIOUS OBSERVANCES:

It is the policy of the University to excuse the absences of students that result from religious observances and to reschedule examinations and additional required classwork that may fall on religious holidays, without penalty. See Faculty Handbook 3.15.2

ADJUSTMENTS FOR PREGNANCY/CHILDBIRTH RELATED ISSUES:

Should you need modifications or adjustments to your course requirements because of documented pregnancy-related or childbirth-related issues, please contact the Accessibility and Disability Resource Center at 405/325-3852 and/or the Institutional Equity Office at 405/325-3546 as soon as possible. Also, see the FAQ on Pregnant and Parenting Students' Rights for answers to commonly asked questions.

FINAL EXAM PREPARATION PERIOD:

Pre-finals week will be defined as the seven calendar days before the first day of finals. Faculty may cover new course material throughout this week. For specific provisions of the policy please refer to OU's Final Exam Preparation Period policy. ***Please note: this class is exempt from the final exam preparation period policy as per §5.15.4.5.I.E.6.***

EMERGENCY PROTOCOL:

During an emergency, there are official university procedures that will maximize your safety.

Severe Weather: If you receive an OU Alert to seek refuge or hear a tornado siren that signals severe weather.

1. Look for severe weather refuge location maps located inside most OU buildings near the entrances
2. Seek refuge inside a building. Do not leave one building to seek shelter in another building that you deem safer. If outside, get into the nearest building.
3. Go to the building's severe weather refuge location. If you do not know where that is, go to the lowest level possible and seek refuge in an innermost room. Avoid outside doors and windows.
4. Get in, Get Down, Cover Up
5. Wait for official notice to resume normal activities.

Additional Weather Safety Information is available through the Department of Campus Safety.

ADDITIONAL REQUIRED UNIVERSITY LEGAL & POLICY STATEMENTS...

THE UNIVERSITY OF OKLAHOMA ACTIVE THREAT GUIDANCE:

The University of Oklahoma embraces a Run, Hide, Fight strategy for active threats on campus. This strategy is well known, widely accepted, and proven to save lives. To receive emergency campus alerts, be sure to update your contact information and preferences in the account settings section at one.ou.edu.

RUN: Running away from the threat is usually the best option. If it is safe to run, run as far away from the threat as possible. Call 911 when you are in a safe location and let them know from which OU campus you're calling from and location of active threat.

HIDE: If running is not practical, the next best option is to hide. Lock and barricade all doors; turn off all lights; turn down your phone's volume; search for improvised weapons; hide behind solid objects and walls; and hide yourself completely and stay quiet. Remain in place until law enforcement arrives. Be patient and remain hidden.

FIGHT: If you are unable to run or hide, the last best option is to fight. Have one or more improvised weapons with you and be prepared to attack. Attack them when they are least expecting it and hit them where it hurts most: the face (specifically eyes, nose, and ears), the throat, the diaphragm (solar plexus), and the groin.

Please save OUPD's contact information in your phone.

NORMAN campus: For non-emergencies call (405) 325-1717. For emergencies call (405) 325-1911 or dial 911.

TULSA campus: For non-emergencies call (918) 660-3900. For emergencies call (918) 660-3333 or dial 911.

FIRE ALARM/GENERAL EMERGENCY:

If you receive an OU Alert that there is danger inside or near the building, or the fire alarm inside the building activates:

1. *LEAVE* the building. Do not use the elevators.
2. *KNOW* at least two building exits
3. *ASSIST* those that may need help
4. *PROCEED* to the emergency assembly area
5. *ONCE* safely outside, *NOTIFY* first responders of anyone that may still be inside building due to mobility issues. *WAIT* for official notice before attempting to re-enter the building.

OU Fire Safety on Campus