

Printed Circuit Board Design
DFTG 2405
Semester and Year

Instructor —

Synonym —

Section Number —

Class Hours —

Office —

Office Hours —

Phone —

Email —

Please contact me if you wish to meet with me outside of regular office hours.

COURSE RATIONALE

Introduction to the fundamentals of printed circuit board design using the Cadence Tools. Overview of the Printed circuit board design process from high level design to final output and manufacture of printed circuit boards. Students will use the Linux operating system on a XP / Linux Workstation Platform. They will also be introduced to some file networking and file manipulation in the creation of a design database, environment setup, directory structures and their relationship to project management and data file storage. Studies will include an introduction to Packaging and Interconnecting Structures, Mechanical, Electrical and Manufacturing design considerations.

COURSE DESCRIPTION

Course includes single-sided and double-sided printed circuit board design, emphasizing the drawings, standards, and processes required to layout printed circuit board and manufacturing documentation. CETT 1403 is recommended.

PREREQUISITES

DFTG 1405 or Departmental Approval.

REQUIRED TEXTS/MATERIALS

Textbook

Student Guide will be provided by faculty.

STUDENT LEARNING OUTCOMES

Course-Level Student Learning Outcomes

Upon successful completion of the course, students will be able to:

- Apply standards required for single-sided, double-sided, and multi-layered printed circuit board layout drawings, utilize industrial techniques to create printed circuit board documentation; layout components for a printed circuit board and create the drawings for a finished printed circuit board (source WECM manual end-of-course outcome)
- Design land patterns to IPC standards
- Design Allegro Pad-stacks and library creation
- Design Allegro Symbols and library creation
- Demonstrate all fundamental operations of the design CAD tool (Cadence Allegro)
- Use Component Placement tools
- Demonstrate Basic Signal Routing
- Use and setup Auto Routing tools
- Prepare and Setup Manufacturing Post-Process
- Implement Design Rules Checking
- Perform necessary Design Preparation post and pre Layout
- Perform a 3rd Party Logic Import

Program-Level Student Learning Outcomes

At the completion of the AAS degree –Electronics Graphics Specialization - the student will be able to:

- E1.** Utilize CAD software to plan and prepare technical graphics and documentation appropriate to the Electrical/Electronic Engineering industry.
- E2.** Utilize CAD software to translate schematics, logic diagrams, and other technical graphics into the physical layout of Integrated Circuits and Printed Circuits
- E3.** Employ CAD-based verification tools and techniques to debug Integrated Circuit layouts.
- I1.** Utilize CAD software to plan and prepare documents and technical graphics appropriate to a range of design, manufacturing, and construction industries.

At the completion of the IC Layout and Design Certificate the student will be able to:

- E1.** Utilize CAD software to plan and prepare technical graphics and documentation appropriate to the Electrical/Electronic Engineering industry.
- E2.** Utilize CAD software to translate schematics, logic diagrams, and other technical graphics into the physical layout of Integrated Circuits and Printed Circuits
- E3.** Employ CAD-based verification tools and techniques to debug Integrated Circuit layouts.

SCANS COMPETENCIES

ARCHITECTURAL & ENGINEERING CAD SCANS FIVE COMPETENCIES

Courses	Resources					Interpersonal					Information					Systems					Technology				
	C1 Allocates Time	C2 Allocates Money	C3 Allocates Material	C4 Allocates Human Resources	C5 Participates as a Member of a Team	C6 Teaches Others	C7 Serves Clients/Customers	C8 Exercises Leadership	C9 Negotiates to Arrive at a Decision	C10 Works with Cultural Diversity	C11 Acquires & Evaluates Information	C12 Organizes & Maintains Information	C13 Interprets & Communicates Information	C14 Uses Computers to Process Information	C15 Understands Systems	C16 Monitors & Corrects Performance	C17 Improves & Designs Systems	C18 Selects Technology	C19 Applies Technology to Task	C20 Maintains & Troubleshoots Technology					
ARCE 1452	✓		✓								✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
DFTG 1405	✓				✓						✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
DFTG 1413	✓				✓			✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
DFTG 1417	✓										✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
DFTG 1433	✓	✓	✓		✓	✓		✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
DFTG 1445	✓		✓	✓	✓		✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
DFTG 1458	✓										✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
DFTG 1475	✓		✓		✓		✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
DFTG 1491*	✓										✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
DFTG 1493	✓							✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
DFTG 1494	✓										✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
DFTG 1495	✓										✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
DFTG 2400	✓				✓						✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
DFTG 2402	✓										✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
DFTG 2405	✓										✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
DFTG 2412	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
DFTG 2419	✓										✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
DFTG 2421	✓					✓		✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
DFTG 2427	✓					✓		✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
DFTG 2428	✓										✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
DFTG 2430	✓							✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
DFTG 2431	✓										✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
DFTG 2432	✓										✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
DFTG 2436	✓					✓					✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
DFTG 2440	✓				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
DFTG 2470	✓										✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
DFTG 2471	✓										✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
DFTG 2473	✓				✓						✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
DFTG 2474	✓										✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
DFTG 2475	✓					✓		✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
DFTG 2476	✓				✓	✓		✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
DFTG 2477	✓			✓	✓	✓		✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
MCHN 1419	✓				✓	✓			✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
ENGLISH																									
MATH																									
Oral Communication																									
Arts & Humanities																									
Social Behavior & Science																									

* = Capstone

ARCHITECTURAL & ENGINEERING CAD SCANS COMPETENCIES

FOUNDATION SKILLS

Courses	Basic Skills					Thinking Skills					Personal Qualities					
	Reading	Writing	Arithmetic/Mathematics	Listening	Speaking	Creative Thinking	Decision Making	Problem Solving	Visualizing	Knowing How to Learn	Reasoning	Responsibility	Self-Esteem	Sociability	Self-Management	Integrity/Honesty
ARCE 1452	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓
DFTG 1405	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
DFTG 1413	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓
DFTG 1417	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓			✓	✓
DFTG 1433	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
DFTG 1445	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓		✓	✓	✓
DFTG 1458	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
DFTG 1475	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
DFTG 1491*	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
DFTG 1493	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
DFTG 1494	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓
DFTG 1495	✓	✓	✓		✓	✓	✓	✓	✓	✓				✓	✓	✓
DFTG 2400	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓				✓	✓
DFTG 2402	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓
DFTG 2405	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓
DFTG 2412	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
DFTG 2419	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓
DFTG 2421	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
DFTG 2427	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
DFTG 2428	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓			✓	✓
DFTG 2430	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
DFTG 2431	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓			✓	✓
DFTG 2432	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
DFTG 2436	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
DFTG 2440	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓		✓	✓
DFTG 2470	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓
DFTG 2471	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓
DFTG 2473	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
DFTG 2474	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓			✓	✓
DFTG 2475	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
DFTG 2476	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
DFTG 2477	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
MCHN 1419	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
ENGLISH																
MATH																
Oral Communication																
Arts & Humanities																
Social Behavior & Science																

* = Capstone

COURSE EVALUATION/GRADING SCHEME

Grades will be determined as follows:

20%	Class Lecture	200
20%	Daily Work	200
10%	Design Project 1	100
20%	Design Project 2	200
30%	Design Project 3	300
100%	TOTAL	1000

*The final course average will be reduced by 1 point for each ***unexcused*** absence.

Grades:

A: 90 - 100 **B:** 80 – 89 **C:** 70 – 79 **D:** 60-69 **F:** 0 - 59

INSTRUCTIONAL METHODOLOGY

This course is taught in the classroom in a lecture/laboratory format. The lecture will generally introduce concepts and skills, which will then be developed and applied in the laboratory.

OPEN LABS

Hours for the open lab will coincide with the tutoring schedule which will be posted during the first week or two of the semester. **You may not be able to complete all the assignments in class**, so the open lab is one of your best opportunities to get help in finishing the lab exercises.

COURSE OUTLINE/CALENDAR

DFTG 2405 PCB DESIGN - COURSE OUTLINE/GRADING CHART

UNIT	SUBJECT	LECTURE		DAILY WK	PROJECT
Intro	Intro to course	X	10	5	
1	PCB Design Overview	X	10	10	
2	Allegro PCB Editor Overview	X	10	10	
3	Start Design Project 1	X	20	10	
	Labor Day Holiday				
	Library Development			10	
	Library Development			5	
	Library Development			5	
	Design Project 1 Due				100
4	Start Design Project 2 Import Logic	X	20	10	
5	Design Rules/Stack-up	X	20	10	
6	Placement	X	20	15	
	Placement			5	
	Placement			5	
7	Routing	X	20	15	
	Routing			5	
	Routing			5	
	Routing			5	
	Routing			5	
	Routing			5	
	Design Project 2 Due				200
8	Start Design Project 3/Lib Development	X	50	10	
	Library Development			5	
	Import Netlist/Design Rules & Stack-up			5	
	Placement/Routing			5	
	Placement/Routing			5	
	Placement/Routing			5	
	Placement/Routing			5	
	Placement/Routing			5	
9	Manufacturing Output	X	20	10	
	Manufacturing Output			5	
	Design Project 3 Due				300
TOTAL		200	200	200	600

(Note: Schedule subject to change depending on pace of course)

COURSE/DEPARTMENTAL POLICIES FOR STUDENTS

Attendance/Class Participation

Students accruing more than two (2) UNEXCUSED absences may be withdrawn from the course at the instructor's discretion. Students may make-up absences by attending other classes. It is the student's responsibility to inform instructor when circumstances prevent him/her from attending class. An instructor may lower a student's final grade for a course due to excessive absences.

Cell Phones and Electronic Devices

To avoid disturbing or distracting others during class or open lab times, students are requested to conduct personal communications of any sort outside of the classrooms. For this reason, the use of cell phones and other PDA's by students is prohibited inside A&E CAD classrooms (this includes placing or receiving phone calls, text messages and emails). When conducting personal communication in the hallways, please control the volume of your voice so as not to disturb students in nearby classrooms.

Use of Recording Devices in Class

Students must receive explicit permission from the instructor prior to recording class activities including lectures and demonstrations using *any* type of recording medium including cell phones, Google Glass, or other devices.

Use of Vaporized Nicotine Products

Use of vaporized nicotine products is prohibited on all ACC campuses.

Withdrawal Policy

It is the responsibility of each student to ensure that his or her name is removed from the roll should he or she decide to withdraw from the class. The instructor does, however, reserve the right to drop a student should he or she feel it is necessary. If a student decides to withdraw, he or she should also verify that the withdrawal is submitted before the Final Withdrawal Date. The student is also strongly encouraged to retain their copy of the withdrawal form for their records.

Students who enroll for the third or subsequent time in a course taken since Fall, 2002, may be charged a higher tuition rate, for that course.

State law permits students to withdraw from no more than six courses during their entire undergraduate career at Texas public colleges or universities. With certain exceptions, all course withdrawals automatically count towards this limit. Details regarding this policy can be found in the ACC college catalog.

Incompletes

An instructor may award a grade of "I" (Incomplete) if a student was unable to complete all of the objectives for the passing grade in a course. An incomplete grade cannot be carried beyond the established date in the following semester. The completion date is determined by the instructor but may not be later than the final deadline for withdrawal in the subsequent semester.

Policy on Late or Missing Work

Instructors may impose a late penalty on work that is submitted after the assigned due date.

Statement on Scholastic Dishonesty

Representing the work of another person as your own work is considered scholastic dishonesty by the A&E CAD department. Academic work submitted by students shall

be the result of their own thought, research or self-expression. Actions constituting scholastic dishonesty include, but are not limited to, plagiarism, cheating, fabrication, collusion, and falsifying documents. Penalties for scholastic dishonesty will depend upon the nature of the violation and may range from lowering a grade on one assignment to an "F" in the course, the assignment being replaced with a different project with a reduced maximum grade, and/or expulsion from the college. See the Student Standards of Conduct and Disciplinary Process and other policies at <http://www.austincc.edu/current/needtoknow>.

Reproduction or transmission of A&E CAD Departmental Check Prints in any manner (including photography and scanning) is a violation of the A&E CAD department's Scholastic Dishonesty policy.

Sharing a drawing file of a class project with another student, or representing another's file as your own work, is a violation of the department's Scholastic Dishonesty policy.

Student Rights and Responsibilities

Students at the college have the rights accorded by the U.S. Constitution to freedom of speech, peaceful assembly, petition, and association. These rights carry with them the responsibility to accord the same rights to others in the college community and not to interfere with or disrupt the educational process. Opportunity for students to examine and question pertinent data and assumptions of a given discipline, guided by the evidence of scholarly research, is appropriate in a learning environment. This concept is accompanied by an equally demanding concept of responsibility on the part of the student. As willing partners in learning, students must comply with college rules and procedures.

Statement on Students with Disabilities

Each ACC campus offers support services for students with documented disabilities.

Students with disabilities who need classroom, academic or other accommodations must request them through the office Student Accessibility Services (SAS). Students are encouraged to request accommodations when they register for courses or at least three weeks before the start of the semester, otherwise the provision of accommodations may be delayed.

Students who have received approval for accommodations from SAS for this course must provide the instructor with the 'Notice of Approved Accommodations' from SAS before accommodations will be provided. Arrangements for academic accommodations can only be made after the instructor receives the 'Notice of Approved Accommodations' from the student.

Students with approved accommodations are encouraged to submit the 'Notice of Approved Accommodations' to the instructor at the beginning of the semester because a reasonable amount of time may be needed to prepare and arrange for the accommodations.

Additional information about Student Accessibility Services is available at <http://www.austincc.edu/sas>

Safety Statement

Austin Community College is committed to providing a safe and healthy environment for study and work. You are expected to learn and comply with ACC environmental, health and safety procedures and agree to follow ACC safety policies. Additional information on these can be found at <http://www.austincc.edu/ehs>. Because some health and safety circumstances are beyond our control, we ask that you become familiar with the Emergency Procedures poster and Campus Safety Plan map in each classroom. Additional information about emergency procedures and how to sign up for ACC Emergency Alerts to be notified in the event of a serious emergency can be found at <http://www.austincc.edu/emergency/>.

Please note, you are expected to conduct yourself professionally with respect and courtesy to all. Anyone who thoughtlessly or intentionally jeopardizes the health or safety of another individual will be dismissed from the day's activity, may be withdrawn from the class, and/or barred from attending future activities.

You are expected to conduct yourself professionally with respect and courtesy to all. Anyone who thoughtlessly or intentionally jeopardizes the health or safety of another individual will be immediately dismissed from the day's activity, may be withdrawn from the class, and/or barred from attending future activities.

Use of ACC email

All College e-mail communication to students will be sent solely to the student's ACCmail account, with the expectation that such communications will be read in a timely fashion. ACC will send important information and will notify you of any college related emergencies using this account. Students should only expect to receive email communication from their instructor using this account. Likewise, students should use their ACCmail account when communicating with instructors and staff. Information about ACCmail, including instructions on setting up an account, can be found at <http://www.austincc.edu/accmail/>

Blackboard (Bb)

Blackboard will be used for some portion of this course to include but not limited to:

- Distribution of handouts and readings
- Submissions of assignments and activities
- Grading

As instructed by your professor, students may be required to access instructional materials via Blackboard.

Student and Instructional Services

ACC strives to provide exemplary support to its students and offers a broad variety of opportunities and services. Information on these services and support systems is available at: <http://www.austincc.edu/support/>

Links to many student services and other information can be found at: <http://www.austincc.edu/>

ACC Learning Labs provide free tutoring services to all ACC students currently enrolled in the course to be tutored. The tutor schedule for each Learning Lab may be found at: <http://www.austincc.edu/tutor>

For help setting up your ACCeID, ACC Gmail, or ACC Blackboard, see a Learning Lab Technician at any ACC Learning Lab.

Freedom of Expression:

Each student is strongly encouraged to participate in class. In any classroom situation that includes discussion and critical thinking, there are bound to be many differing viewpoints. These differences enhance the learning experience and create an atmosphere where students and instructors alike will be encouraged to think and learn. On sensitive and volatile topics, students may sometimes disagree not only with each other but also with the instructor. It is expected that faculty and students will respect the views of others when expressed in classroom discussions.

All discussion or conversation in the classroom should be appropriate and respectful of others.

Ownership of Student Work:

The Architectural & Engineering Computer Aided Design (A&E CAD) Department reserves the right to retain any and all student work (including but not limited to: original work, scans, photographs, and copies of student work) completed as A&E CAD course work for the purposes of documentation, accreditation, evidence of student performance, university transfer, marketing or any other purpose supporting the mission of the Department and Austin Community College.

Concealed Handgun Policy

The Austin Community College District concealed handgun policy ensures compliance with Section 411.2031 of the Texas Government Code (also known as the [Campus Carry Law](#)), while maintaining ACC's commitment to provide a safe environment for its students, faculty, staff, and visitors.

Beginning August 1, 2017, individuals who are licensed to carry (LTC) may do so on campus premises except in locations and at activities prohibited by state or federal law, or the college's concealed handgun policy.

It is the responsibility of license holders to conceal their handguns at all times. Persons who see a handgun on campus are asked to contact the ACC Police Department by dialing 222 from a campus phone or 512-223-7999.