

MELTEC 229
Commercial & Industrial Wiring - Course Syllabus

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A foreword

Commercial and Industrial Wiring is a discipline that requires multiple abilities. Some abilities are eminently technical, such as the ability to predict circuits' outcomes, which is indispensable when designing or troubleshooting; others closer to the art of craftsmen, such as conduit bending, wire harnessing, or panel's arrangements, where although there are techniques to solve problems, the years of practice make a difference in the quality of the final product. The intention of this class is to expose students to practical situations where both phases are present. Throughout the course, students will face straight forward problems where the solutions are tied directly to the material covered during the lecture, book, and/or the information in a tech spec or article. In other occasions, students will be exposed to variations of the same themes, and the basic procedures needed to achieve a solution will be exposed along the demos, homework, and labs. These are the real benefits students will receive from this course.

Out of the classroom, in the real world, the acquired knowledge will be applied; and at that point creativeness, character and experience – things that this course can not help develop - will play a role along with knowledge and comprehension. But, in today's hi-tech, fast-paced environments, it will hardly be possible to have chance of building any background, developing any creativeness, or sharpening any character without those foundations that the classroom can deliver.

It's my wish and hope that this course will become for the students a sort of virtual tool box, where the inner resources of comprehension might allow them solve practical problems with a decent level of proficiency, or perhaps, even help them to shine in the workplace.

Adrian De Angelis

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Course Scope [\(Back to INDEX\)](#)

Commercial & Industrial Wiring is a course strongly oriented towards addressing the practical issues any electrical apprentice or trainee is going to face in this highly competitive and demanding trade. Students will perform calculations, will use NEC tables, will bend conduits, will pull wires, will connect devices, will energize circuits, will verify functionality, and will perform measurements.

Most written assignments will be done on a computer, tablet, or smart phone. Students needing support learning how to use digital resources can request and will receive help. Using the student email account, text editors, and spreadsheets will be common tools in this class.

Student Learning Outcomes

At the end of this course the student will be able to:

1. Select conductors, protections, and wiring methods according to necessities based on estimations and NEC rules.
2. Perform all the necessary tasks to wire typical commercial and industrial electrical circuits (conduit work and wiring) with acceptable levels of workmanship.

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Required

1. **Modern Commercial Wiring**, Seventh Edition, Harvey N. Holzman, The Goodheart-Willcox Company Inc.
2. **National Electrical Code**, NFPA

Other readings and resources – Not required although recommended

- **Electrical Wiring – Commercial 16th Edition**, R. Mullin and R. Smith, Delmar Cengage Learning
- **Electrical Wiring – Industrial 16th Edition**, R. Mullin and R. Smith, Delmar Cengage Learning
- **Understanding The National Electrical Code**, Mike Holt, Mike Holt Enterprise Inc.
- **2017 STALLCUP'S Electrical Design Book**, James Stallcup, NFPA

On-line free resources

- <http://deangelisa.faculty.mjc.edu>
- [GENERAL ELECTRIC - GE](#)
- [EATON](#)
- [ROCKWELL AUTOMATION – ALLEN BRADLEY](#)
- [EandM – SIEMENS USA](#)
- [SCHNEIDER ELECTRIC USA](#)

Course Structure ([Back to INDEX](#))

Throughout the semester, the student will learn the principles of wiring, will apply electrical theory and NEC rules to size protections, wires, and wiring methods, and will learn basic rules for load estimation.

The lecture segment of the class, usually the first class of a week, will be focused on wiring principles such as brief surveys of materials used in electrical installations, application of electrical theory and NEC rules, and examples of applications.

The lab segment of the class, usually the second class of a week, will be used for demos, lab activities, and - if needed - review of wiring principles relative to the activities.

The instruction will be delivered in blocks that will be evaluated in summative assessments.

	Approximate time frame	Themes and activities	Reading and homework	Summative Assessment
Introduction	Class 1 Week 1	Syllabus. Review of electrical principles	Modern Commercial Wiring chapters #1 through #4 plus technical reading related to safety programs.	
BLOCK #1 Weeks 1 through 4	Class 2 week 1 through week 3 classes	Conduit bending + Sizing conduits, boxes and wires	Conduit bending exercises Modern Commercial Wiring chapters #5, #6, #7, and #18 + technical reading related to wiring materials and devices	Conduit bending and basic circuit testing.
	Week 4	Basic wiring and circuit testing (basic use of meggers) Start of Lab #1 (2 motors machine wiring: Power and Control)		General application of technical rating and sizing of wires and conduit based on electrical principles and NEC rules
BLOCK #2 Weeks 5 through 8	Classes of weeks 5 through 8	Principles of circuit protection. Sizing of protections, feeders, and grounding.	Modern Commercial Wiring chapters #8, #9, #10, #11 + technical reading related to OCPDs and grounding. Chapter #15 with a technical paper related to UPS.	General application of technical rating and sizing of OCPDs and grounding based on electrical principles and NEC rules
BLOCK #3 Weeks 9 through 12	Classes of weeks 9 through 11	Estimation of electrical loads Troubleshooting exercise. End of Lab 1	Modern Commercial Wiring chapter #12 + technical reading related to these matters.	
	Classes of weeks 11 and 12	Start Lab #2		
BLOCK #4 Weeks 13 through 16	1 st classes of weeks 13 through 16	Special applications	Completion of Modern Commercial Wiring – chapters #13, #14, #16, and #17	Final Exam – Materials covered from week #2 through 12.
	2 nd classes of weeks 13 through 16	General estimation for a small commercial/industrial facility: Lab #6		

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Attendance prior and after Census Day

Attendance will be taken daily. Regular attendance is essential to ensure success in this course and that laboratory procedures are clearly understood.

Students must email giving notice to the instructor if they are planning to miss a class before the end of second week (prior to census day) to avoid being dropped from the course. After the second week, it is the student responsibility to drop this course. If after the second week, and before the completion of the 75% of the course, a student stops attending but forgets to drop the class, the instructor could, unintentionally, overlook the situation and fail to drop the student from the roster. In such case, the final grade will be likely an "F". However, a student showing a pattern of several consecutive missed assignments can be interpreted as a permanent absence in which case the instructor may drop the student without giving previous notice.

Lab Requirements [\(Back to INDEX\)](#)

A safe laboratory environment is essential. Safety procedures are most often given during the lecture period. If, in the opinion of the instructor, you are unaware of the proper safety procedures for a particular laboratory exercise because of excessive absences, you may not be allowed to participate in that exercise. These labs will be developed in a shop-like environment. Therefore, it will be neither a playground nor a freewill space. Workplace rules apply, and the instructor will work both as instructor and supervisor. In such character, the instructor will explain how to perform tasks and will not intervene in the class dynamic unless it is evident that the group is having difficulties. Good results are expected within a reasonable time frame according to different situations.

Most of the labs are designed as a team endeavor; groups of two or three persons will work together. Differences of character might arise and, as it happens in a real work environment, these differences will have to be put aside in order to achieve the successful completion of the work at hand. A professional attitude in front of differences is a calm and cold analysis of the problem, looking for a solution and not for the self-satisfaction of "being the winner" of a discussion. The quality of the team effort will be a factor for a positive evaluation on the lab.

As was previously said, workplace rules apply, such as:

- 1. Be on time**
- 2. Come ready**
 - a. Read the lab material ahead of time,
 - b. Bring your notes (class notes and questions) and your basic class gear (notebook, calculator, pen, pencils, permanent marker)
- 3. After a lab-demo and general indications are delivered, do not spring into action immediately; plan your work and set your area.**
- 4. If a difference of opinions with your team arises, avoid quarrels and discuss differences calmly**
- 5. Don't start working right away; the first important step is to set a clean and clear work area. Don't work to the very last minute of the class, stop 5 to 10 min before the end of the class to clean and organize your area. Productivity is higher in an organized environment.**

You'll be provided with tools, instruments, and safety glasses (better have your own, it is more hygienic). However, it is recommended to have:

1. Safety glasses,
2. Gloves,
3. Working shoes or boots (preferable type "EH"),
4. Tape measure,
5. Permanent marker,
6. A 12" square,
7. A 1/8" straight-head slot screwdriver,

It is **STRONGLY** recommended to have the tetanus vaccine. Students Health Services delivers the shot for a minimum fee. Also, let your instructor know if you suffer from any heart or blood condition that might compromise you in case of cuts or accidental shock.

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Class Participation

Being on-time, staying on-task, and keeping engaged in the subject, although it leaves a large margin for subjectivities from the point of view of the student and the instructor, is going to be considered and awarded. "Class Participation" includes punctuality, readiness, engagement with the subject, cooperation, and team spirit. It will be rewarded with 5 points. Students with leadership that help others to master technical issues may be awarded with 1 extra-credit point in this item.

Class Participation accounts for 5% of the final grade.

Homework

HW is divided between two different types of assignments: Online assignments and estimation problems.

- Most homework assignments will be done online using Canvas, including many numerical problems that must be documented using one of the equation editors embedded into the learning management system.
- Estimation problems also are posted on Canvas, but they are meant to be printed and turned in with their solution according to schedule.
 - Students able to work documents digitally will be able to do these assignments in .DOC, .DOCX, .ODT, or .PDF formats and email them to the instructor

The schedule of the deadlines for assignments will be set accordingly to the development of the class and posted on Canvas.

For each hour of lecture two hours of home study are expected, therefore students should plan 4 hours per week of dedicated time for reading and completing assignments. Since this course is structured in blocks, the amount of dedicated time for studying and doing assignments shall be the number of weeks budgeted for the block times 4 (four). E.g.: Block #1 is estimated to be four weeks long and therefore it will require 16 uninterrupted hours of studying and homework.

Usually, the deadline for HW will be seven to ten days after it is officially assigned; in that way students will have plenty time to consult the instructor prior to turning in HW. Homework is not a medium to test but to consolidate understanding. Students can and should ask about difficulties that they encounter in assignments, as well as show the instructor drafts of written assignments prior to turning them in. Homework is the best tool to identify what is not clear and make it crystal clear. Homework is meant to learn and not to test.

Using Canvas Learning Management System makes studying and doing homework virtually ubiquitous; all that it takes is a digital device (computer, laptop, tablet, or smart phone) and an Internet connection. Students will be able to take school virtually wherever there is Internet access. For the digitally literate, even written assignments could be done digitally. Some students may have difficulties working with a digital medium, but they will receive support in the form of training to manage digital resources. Students with material limitations when it comes to accessing devices and digital resources will receive orientation on how to get support from the College and the Community in order to overcome these limitations. The world and the workplace are turning more and more into a digital space and the classroom must follow in order to prepare students for new professional requirements.

HW accounts for 30% of the final grade ([Back to INDEX](#))

Labs

In the lab environment, SAFE WORK PRACTICES apply. WEAR SAFETY GLASSES at all times. Instructor will indicate when it is safe to access spaces with energized conductors.

There are two labs. Lab #1 is a quasi-full installation including a troubleshooting session. Lab #2 is a design project following guidelines and limitations of the National Electrical Code.

Lab #1 is a full practicum of wiring of power and control circuits including conduit bending.

- The blueprint related to this lab will be analyzed in stages; after the analysis session, a test will be taken related to that segment and the highest grade of the team will be the team leader for that segment of the lab.
- The team leader is the one that will wear the tool pouch and will be the liaison with the instructor for coordination purposes. Team leaders will receive a 5% premium on the lab grade related to that segment.
- The members of the class will be organized in 6 teams of 3 members and assigned to a trainer with two equipped tool boxes and a storage chest. These teams will be crewed in the first week through a draw. Each team will be responsible for a full tool set stored in the tool boxes. The keys to open the tool boxes will be given each class. The contents of the tool boxes are inventoried and displayed in a picture in CANVAS.
- After each lab period the tool boxes will be inspected. The evaluation of the cleanness and neatness of the work area (trainer + tool boxes + storage chest) will be part of the grading for labs. Messy tool boxes and unclean work areas will be penalized. Teams must report broken tools; not reporting a broken tool will be heavily penalized – if a broken tool is reported immediately no penalization will be applied. Student will be accountable for missing tools. 1% of the lab grade will be discounted for every 5 minutes the instructor has to spend in cleaning or organizing tools in the tool boxes.

- Labs are expected to be completed within the timeframe specified when the class agenda is set, but periods of catch up will be available to complete tasks. Basically, labs will be evaluated based on their functionality and their completion with a reasonable level of craftsmanship. Work ethic and teamwork are factors that will affect the overall evaluation of the lab. There are some less subjective matters on the evaluation of the development of labs such as:
 1. Methodicalness – proved through measurement charts or field notes
 2. Finishing (lack of burrs, tightness, lack of kinks, “squareness”)
 3. Prompt functionality
 4. Completeness – proved through the completion of tasks requested by the lab guide
 5. Neatness in the project, the work space, and the related documentation.

Lab #2 teams will be arranged based on the convenience of students able to gather in a study area. Teams for lab #2 shall be of no more than 5 members and it will require an intense use of the NEC. A project of an electrical system will be laid out from a blueprint with technical specifications. The conclusion of this lab will include the estimations, rating, and sizing of the service entrance and service entrance equipment, and the distribution of circuits with the estimation, rating, and sizing of branch circuits and feeder(s). The grading of Lab #2 will be based on one of the documented blueprints used by the team and the grade will be the same for all the team members.

Labs account for 25% of the final grade

Exams

Summative assessments will be held after an instructional block is completed. They will be focused on the subjects covered in the block. Theoretical and practical subjects will be evaluated. The Electrical Field Reference Handbook and a calculator will be necessary and allowed. The summative assessments will represent **20% of the final grade**.

The Final Exam is THE ULTIMATE SUMMATIVE ASSESSMENT. It is the culmination of this course, and will be strictly numeric and NEC based. It will be held in the sixteenth week. A calculator will be necessary and the Electrical Field Reference Handbook will be allowed as the only reference. ***The final exam represents 20% of the final grade and it must be at least a 50% in order to pass.*** Not taking the final exam, or having an F as grade, automatically disqualifies a student who will then not pass the course. Only in a very special case does a student that misses the Final receive an incomplete grade (IF or ID) in order to give him/her the opportunity to take the exam another day. Failing to do so will result in an automatic F or D.

In summary

Participation	=	5%
Homework	=	30%
Labs	=	25%
Summative Assessments	=	20%
Final	=	20%

Grades

A “C” is required to successfully complete this course. That is the equivalent of the 70% of the total points (gathered between participation, homework, labs, and exams) with the strict condition of having at least the 50% of the final exam. Many students express test-taking anxiety with the consequent low performance, but notice that 60% of the grade is not based on testing but in personal effort, commitment, and the achievement of measurable goals. 100%, or a very high score, in HW, Labs, and Class Participation is possible, and in such cases, a mediocre performance in tests will be not a handicap to pass the class.

The grading scale is as follows:

A = 90 to 100%

B = 80 to 89%

C = 70 to 79%

D = 50 to 69%

F = up to 49%

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Students enrolled in the DAS as electrical trainees (Electrical Trainee – ET – working for a licensed contractor or under the supervision of a journeyman) will log 105 hours of technical education of the 150 required in a year, but must pass with a C or better in order to be accredited with the hours.

Keys for success

- Start reading the class material immediately after or concurrently with the delivery of subjects. Take care of homework as soon as it is assigned. HW is related to the reading material. Answer the “Review Questions” and the “Using the NEC” questions at the end of each chapter of the textbook; that will make your reading more effective and your online homework easier to complete.
- Keep the HW questions next to you and answer the questions as soon as you found the key paragraphs that are related to the point. Summarize the main points. Good summaries will help you prepare for exams. Mark the text or keep notes on subjects that are not clear in order to ask for clarification the following class.
- Keep track of what HW you’ve turned in, the state of your labs, and the grades you are obtaining. These elements will give you a good idea of your progress and will show the areas that you need to work out.
- Remember: Homework is not a medium to test but to consolidate understanding. Students can and should ask about difficulties that they encounter in assignments, as well as show to the instructor drafts of written assignments prior to turning them in. Homework is the best tool to identify what is not clear and make it crystal clear. Homework is meant to learn and not to test.
- It is not a bad idea to organize some group sessions to review concepts and get ready for exams.
- Since “Commercial and Industrial Wiring” is a very broad subject, lectures and readings complement each other. The reading material, however, will not only cement the lecture topics, but it will also provide a wider view of the issues discussed. For this reason, IT IS VERY IMPORTANT to read and annotate the material, highlighting issues that might not result clear to you, so that you can ask for clarification during the following class session.
- Keep books, notes, and personal gear together.

- Formal education, such as this class, is a short term commitment with long term consequences. Some family matters – little league, Halloween, a fishing trip, etc... - may need to take the back seat for a while. It is up to the instructor to do the utmost to deliver good content, but up to the student to achieve success. [\(Back to INDEX\)](#)