Washtenaw Community College

ELE 134 – Motors and Controls

CRN 16280 Section 01 MW 12-3 pm (TI 143) – Winter 2013

Instructor: Dale Petty

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Websites: https://blackboard.wccnet.edu/ http://courses.wccnet.edu/~petty/

Office: TI 122C

Office Hours: My schedule is posted in TI 122 and at
http://www4.wccnet.edu/search/officehours/pdf/officehours.pdf
Please make an appointment for other times.

Prerequisites: ELE 111 Electrical Fundamentals or permission of instructor

Materials: *Motors, 2nd edition, NJATC, ISBN 978-0-8269-1982-3*
Coursepack: *ELE 134 Motor and Controls, 3rd Edition,* ©Dale Petty 2012.
3-Ring binder (for Coursepack and other materials)
Scientific calculator (not a cell phone)

Format: We will spend about four hours per week doing lecture, discussion and assessment, and two hours per week in lab.

Homework: You should expect to spend at least 8 hours per week reading, working problems, preparing for lab, discussing with classmates and studying for exams. I recommend that you do a quick overview of the reading assignment before the lecture and a thorough reading following the lecture. Homework problems should be done following the lecture and before the next class so that you arrive prepared to share questions and insights. Homework will be discussed in class, but will not be collected.

Labs: Please follow appropriate safety practices in the lab!

You should prepare for each lab by reading over the lab instructions and doing as much of the lab as you can on paper. Then when you get to the lab, you'll have enough time to complete it.

Labs will be done in teams of two unless otherwise noted. Please work with your lab partner to share the work equally. Regularly check in with your partner and ask how you can help them learn, and let your partner know what is helpful to you.

It is important to do the labs step-by-step as written to protect yourself, the equipment and to obtain the correct results. Please pay particular attention to the warnings given in the lab instructions. Wait for your instructor's sign-off if directed to do so in the lab instructions.

When you feel your lab is complete, complete the Questions with your lab partner. Feel free to ask your classmates for help. Ask your instructor to review the lab with you and sign your lab sheet before you turn it in. If you run short on time, you may complete the Questions outside of class.

A Saturday morning Open Lab, staffed by our lab assistant, Dennis Kilgore, is available for students to finish lab work not completed during class. Make arrangements with Dennis or your instructor if you wish to make up a lab at a different time.

Put your name on your lab and staple together all of the lab pages when submitting your lab for grading. Labs will be graded on completeness and correctness. There is a 1 point penalty for labs turned in more than a week after they are assigned.

Quizzes: There will be regular quizzes throughout the semester. You may use a calculator (not a cell phone), and one 8 ½" x 11" crib sheet (both sides). You must do your own work unless otherwise noted. Missed quizzes may not be made up, however the grade for any missed quizzes will be raised to match your final exam grade percentage.

Task Checkups: There will be regular evaluations of your practical skills throughout the semester. These evaluations will be time limited, and crib sheets will not be allowed. If you score less than 100% on a Task Checkup, you may retake it, with a minimum of 1 week between attempts.

Final Exam: A comprehensive final exam will be given at the end of the semester. You may use a calculator (not a cell phone), and one 8 ½ x 11" crib sheet (both sides).

Grading: Your final grade will be based on the total number of points accumulated during the semester as follows:

Labs (5 points each)	~ 17 % of your grade
Quizzes (10 points each)	~ 33 % of your grade
Task List (8 points each)	~ 27 % of your grade
Final Exam (100 points)	~ 24 % of your grade

Letter grades will be assigned according to the following scale.

A	93 - 100 %	C	73 - 76 %
A-	90 - 92 %	C-	70 - 72 %
B+	87 - 89 %	D+	67 - 69 %
B	83 - 86 %	D	63 - 66 %
B-	80 - 82 %	D-	60 - 62 %
C+	77 - 79 %	F	0 - 59 %

W Student withdrew from class by submitting a drop form to Student Records

I An incomplete may be given in the event of extreme circumstances near the end of the semester when only a few assignments remain to be completed.

Please Note:

- Please keep drink containers covered, and take responsibility for disposing of your trash and repairing any damage done to equipment from spilled drinks.
- Container recycling bins in the classrooms and in the TI building lobby are for all glass, plastic and metal beverage containers.
- Paper recycling bins in the classrooms and hallways are provided for office and notebook paper and grayboard (no napkins, tissues, etc.)
- Trash containers are provided for all your non-recyclables. Please clean off your bench at the end of each class.
- Please remove your personal flash drives and diskettes at the end of each lab.
- Multi-meters and tools are available on request for use in class. Ask your instructor if you need help finding them. At the end of class, please return whatever you have borrowed.
- Comfortable, adjustable seating: please keep shoes and sharp objects off.

Support:

Extra help is available from your instructor after class, during office hours or by appointment. You can contact any of your classmates by email through BlackBoard. *Learning Support Services* provides tutoring for all enrolled students. Please see the schedule posted outside LA 104 as times may change each semester. If you need an academic accommodation because of a disability, please advise me and make an appointment with Learning Support Services as soon as possible to verify the disability and arrange accommodations. Call (734) 973-3342 or stop by LA 104, Monday – Friday, 8-5.

Washtenaw Community College Board of Trustees Policies

4095 -- STUDENT RIGHTS AND RESPONSIBILITIES – Academic Dishonesty

All forms of academic dishonesty including but not limited to collusion, fabrication, cheating, and plagiariCP will call for discipline.

1. Collusion is defined as the unauthorized collaboration with any other person in preparing work offered for individual credit.

2. Fabrication is defined as intentionally falsifying or inventing any information or citation on any academic exercise.

3. Cheating is defined as intentionally using or attempting to use unauthorized materials, information, or study aids in any academic exercise.

4. Plagiarism is defined as the appropriation of any other person's work and the unacknowledged incorporation of that work in one's own work offered for credit.

ELE 134 - Course Outcomes

1. Identify the principles of operation of DC and AC electrical machines including: motors, motor controls, generators and transformers.
2. Select and wire motors, motor controls, generators and transformers utilizing nameplate information, code books and electrical diagrams.
3. Test and troubleshoot and motors, motor controls, generators and transformers utilizing electrical diagrams and test equipment.
4. Configure and troubleshoot electronic motor drives.

ELE 134 – Major Instructional Objectives

1. Identify the construction, principles of operation, and operating characteristics of **DC motors and generators** including: series, shunt and compound.
2. Analyze the operation of common **DC motor control** circuits including: stop/start, forward/reverse, brake, speed change, and overload protection.
3. Identify the construction, principles of operation, and operating characteristics of **three phase transformers**.
4. Identify the construction, principles of operation, and operating characteristics of **three phase alternators**.
5. Determine power, voltage, and current for **delta and wye connected three phase circuits.**
6. Recognize the construction, principles of operation, and operating characteristics of **single and three phase AC motors** including: squirrel cage induction, synchronous, wound rotor, split phase, capacitor start, capacitor start/capacitor run, PSC, shaded pole and universal.
7. Analyze the operation of common **three phase motor control** circuits including: stop/start, forward/reverse, brake, jog/run, speed change, and overload protection.
8. Identify the construction, principles of operation, and operating characteristics of **servo and stepper motors and controls**.
9. Interpret and apply the information commonly found on a **motor nameplate**.
10. Connect DC motor and generator circuits.
11. Connect three phase alternators, transformers and loads in common configurations.
12. Determine the required conductor size and over current protection for **installation of a three phase motor**.
13. Connect single phase and three phase motor circuits.
14. Identify the common reasons for DC motor and generator failure, their causes, and solutions.
15. Demonstrate the use of a systematic procedure to **troubleshoot DC generators, motors and controls,** using ladder diagrams and test equipment.
16. Identify the common reasons for single and three phase motor failure, their causes, and solutions.
17. Demonstrate the use of a systematic procedure **to troubleshoot single phase and three phase motors and controls** using ladder diagrams and test equipment.
18. Demonstrate the use of test equipment such as ohmmeters, meggers, digital multimeters, clamp-on ammeters, and phase sequence meters to test DC and AC machines.
19. Identify the principles of operation of **solid state motor controls** for DC and AC motors.
20. Wire, program and troubleshoot solid state motor drives such as VFDs and servo drives.

ELE 134 - Motors and Controls – Winter 2013 Course Outline (tentative)

Instructor: Dale Petty email: petty@wccnet.edu phone: 734-677-5108

Wk	Date	Topics	Reading & Homework	Labs
1	Mon, 01/14	**Electrical Safety – shock, arc fault, procedures, equipment** videos testing	Electrical Safety Handouts Electrical Safety (CP)	
2	Wed, 01/16	**DC Generators:** construction, theory of operation, types of generators, operating characteristics **Schematic and Wiring Diagrams** **1/21 – MLK Day - No Class!**	Motors: pp. 210-212, 226-230 Output Polarity and Build-up (CP) HW - DC Generators	Lab 1 – Introduction to DC Generators Lab 2 - Load Characteristics of a Compound DC Generator (extra credit)
3	Mon, 01/28	**DC Motors:** construction, theory of operation, types of motors, operating characteristics Intro to Motors (video): Library # TK2435 .E53 2007 [PT.]1 DC Motor (video): Library # TK2435 .E53 2007 [PT.]2	Motors: pp 208-226, 231-237 Video Study Questions - DC Motors (CP) HW - DC Motors 1 (CP)	Lab 3 – Construction of a DC Motor Lab 4 – Operating Characteristics of DC Motors
4	Mon, 02/04	**DC Motor Control:** control functions, ladder diagrams, relays and starters	Motors: pp 238-245 Rules for Relay Ladder Diagrams (CP) Square D Motor Control Circuits (Handout) HW - DC Controls (CP)	Lab 5 - DC Motor Controls 1 - Start/Stop
6	Mon, 02/11	**DC Motor Troubleshooting and Maintenance:** troubleshooting, maintenance, causes of failure Maintaining Motors (video): Library # TK2435 .E53 2007 [PT.]5	Motors: pp 324-405, 406-416, 421-430, 434-438, 444, 452, 456, 457 Troubleshooting Guide for DC Motors (CP) Video Study Questions – Maintaining Motors (CP) HW - DC Controls 3 (CP)	Lab 6 - DC Motor Controls 2 – Inch/Jog/Speed Lab 7 – DC Motor Controls 3 – Forward/Reverse/Brake (extra credit)

Wk	Date	Topics	Reading & Homework	Labs
5	Mon, 02/18	**3 Phase Power:** delta and wye connections, voltage, current and power calculations **3 Phase Transformers:** configurations, calculations, wiring	Kaiser: pp 82-121 HW – 3 Phase AC Fundamentals (CP) HW – 3 Phase Transformers (CP)	Lab 8 - 3 Phase AC Measurements Lab 9 - 3 Phase Transformers
7	Mon, 02/25	**3 Phase Alternators:** construction, theory of operation, operating characteristics, paralleling alternators **3/4 and 3/6 Winter Recess – no class!**	Motors: pp. 54-71 HW – Alternators (CP)	Lab 10 - Operating Characteristics of 3 Phase Alternators Lab 11 – Paralleling an Alternator with the Distribution System (extra credit)
8	Mon, 03/11	**3 Phase Motors:** construction, theory of operation, operating characteristics AC Motors (video): Library # TK2435 .E53 2007 [PT.]3	Motors: pp. 72-103, 104-115 Video Study Questions - 3 Phase AC Motors (CP) HW – 3 ϕ AC Motors (CP)	Lab 12 - 3 Phase Squirrel-Cage Induction Motors
9	Mon, 03/18	**Motor Selection and Installation** Reading a nameplate, NEC installation requirements, megger, phase sequence tester Motor Nameplates (video): Library # TK2435 .E53 2007 [PT.]4	Motors: pp 19-53, 180-207 Motor selection and installation handouts Video Study Questions - Motor Nameplates (CP) HW – Motor Selection & Installation (CP)	Lab 13 - Motor Nameplates, Installation and Testing
10	Mon, 03/25	**3 Phase Motor Control:** 3 phase motor starters, control functions	Motors: pp 238-295 HW – 3 Phase Motor Control (CP)	Lab 14 – AC Motor Controls 1 – Start/Stop/Reverse/Speed Change Lab 15 – AC Motor Controls 2 - Braking
11	Mon, 04/01	**3 Phase Motor Troubleshooting:** systematic procedure using multimeter Troubleshooting Motors (video): Library # TK2435 .E53 2007 [PT.]6 Troubleshooting Motors (CD-ROM)	Motors: pp 406-421, 428-457 Systematic Troubleshooting Procedure (CP) Elements of a Motor Control System (CP) Troubleshooting Situations from Teletrain Video (CP) HW – 3 Phase Motor Troubleshooting	Lab 16 - Motor Troubleshooting Simulation 1 Lab 17 - Motor Troubleshooting Simulation 2 (extra credit)
12	Mon, 04/08	**Synchronous and Wound Rotor Induction Motors** – construction, theory of operation, wiring, operating characteristics	Motors: pp 116-129, 130-157 HW – Other 3 Phase Motors (CP)	Lab 18 – Synchronous Motors Lab 19 - Wound Rotor Induction Motors (extra credit)

Wk	Date	Topics	Reading & Homework	Labs
13	Mon, 04/15	**Electronic Motor Drives:** solid state components, drives for DC, universal and AC motors, variable frequency drives -wiring, programming and troubleshooting DC Motor Controls (video): Library # TJ213 .S65 2007 [PT.]3 AC Inverters (video): Library # TJ213 .S65 2007 [PT.]1	Motors: pp 296-323 Switching… PFM AC Drive (CP) Voltage… PWM AC Drive (CP) Torque and HP.. AC Drive (CP) HW – Electronic Motor Drives (CP)	Lab 20 – Testing Solid State Components Lab 21 – Variable Frequency Drives
14	Mon, 04/22	**Single phase motors:** construction, theory of operation, types of single phase motors, wiring, troubleshooting	Motors: pp 158-179 Single Phase Motor Characteristics (CP) HW – Single Phase Motors (CP)	Lab 22 - Single Phase AC Motors – Starting Characteristics Lab 23 – Single Phase AC Motors – Running Characteristics
15	Mon, 04/29	**Servo and Stepper Motors:** construction, electronic drives, wiring, programming, troubleshooting Servo and Stepper Motor Controls (video) Library # TJ213 .S65 2007 [PT.]2 **Last Saturday Open Lab 5/4/2013**	Motors: pp 458-473 HW – Servo and Stepper Motors (CP)	Lab 24 – Stepper Motors
	Mon, 05/06	**Final Exam**		