MECH3630 Electrical Technology

Course Code: MECH3630	**Course Title:** Electrical Technology
Required Course Or Elective Course: required	**Terms Offered (Credits):** Spring (3 credits)
Faculty In Charge: Yongsheng Gao	**Pre/Co-Requisites:** NA

Course Structure: Lecture: 2 days per week, 3 hours; Lab: 1 day per week, 1 hour; Tutorial: 1 day per week, 1 hour

Textbook/Required Material:

P. C. Sen, Principles of Electric Machines and Power Electronics, third edition, Wiley, 2013.

Bulletin Course Description:

Theoretical and practical treatment of key elements in electrical technology with industrial applications. Main topics include magnetic circuits, transformers, electrical machines, and applications for industrial automation.

Course Topics:

1. Magnetic Circuits (1.5 weeks)
2. Hysteresis
3. Sinusoidal excitation
4. Permanent magnet

5. Transformers (2 weeks)
6. Construction and working principle
7. Equivalent circuit analysis
8. Autotransformers and three-phase transformers

9. Electromechanical Energy Conversion (0.5 weeks)
10. Energy conversion process
11. Field energy
12. Mechanical force in the electromagnetic system
13. Rotating machines

14. DC Machines (3 weeks)
15. Motor and generator principles
16. Speed-torque characteristics of series, shunt, and compound wound motors

17. Induction (asynchronous) Machines (3.5 weeks)
18. Construction and principle of action of squirrel cage motors
19. Speed control and starting method
20. Equivalent circuit analysis
21. Speed-torque characteristics

22. Synchronous Machines (0.5 weeks)
23. Construction and principle of action
24. Equivalent circuit analysis
25. Speed-torque characteristics

26. Single-Phase Motors (0.5 weeks)
27. Double revolving field theory
28. Equivalent circuit analysis
29. Speed-torque characteristics

30. Special Machines (0.5wks)
31. Servomotors
32. Synchros
33. Stepper motors

34. Transients and Dynamics (0.5wks)
35. DC machines
36. Synchronous machines
37. Induction machines
38. Transformer

39. Power Semiconductor Converters (0.5 wks)
40. Power semiconductor devices
41. Controlled rectifiers
42. AC voltage controllers
43. Choppers
44. Inverters and cycloconverters

Course Objectives: (correlated program objectives)	1. To equip students with fundamental theories and technologies in electromechanical energy conversion (P-O1, P-O2, P-O3) 2. To introduce students structures, working principle, and load characteristics of key electromechanical devices such as transformer, DC machine, and induction machine (P-O1, P-O2, P-O3). 3. To provide students extensive training in development and use of equivalent circuit for magnetic circuit and device analysis for engineering design (P-O1, P-O2, P-O3). 4. To introduce students practical issues that affect safety and energy efficiency (P-O4)
Course Outcomes: (correlated course objectives and program outcomes)	A. Ability to use basic knowledge in physics and mathematical tool to develop new analysis tools, concepts, and models (1,3) (POC1, POC3). B. Ability to use electromechanical devices, such as transformers, DC machines, induction machines, and power devices for mechanical system design and development (4) (POC4). C. Ability to conduct design analysis for products that involve electromechanical energy conversion (1-3) (POC1, POC3, POC4). D. Awareness of safety issues in use of electromechanical devices and power devices (4) (POC9, POC10)
Assessment Tools: (correlated course outcomes)	Homework -15% (A-D) Lab – 15% (B, D) Mid Term and Final Exams – 70% (A-D)

BEng in Mechanical Engineering (4-year program)

Program Objectives:

P-O1. Be able to communicate and perform as an effective engineering professional in both individual and team-based project environments,

P-O2. Have an international outlook with clear perspectives on the Pearl river Delta and Greater China,

P-O3. Be able to research, design, develop, test, evaluate and implement engineering solutions to problems that are of complexity encountered in professional practice and leadership,

P-O4. Clearly Consider the ethical implications and societal impacts of engineering solutions,

P-O5. Continuously improve through lifelong learning.

Program Outcomes:

POC1. ability to identify and formulate problems in multidisciplinary environment with an understanding of engineering issues and constraints;

POC2. ability to design and conduct experiments as well as analyze and interpret data;

POC3. ability to apply knowledge of mathematics, science, and engineering for problem solving in mechanical engineering and related sectors or for further education in a research career;

POC4. ability to develop specification and to design system, component, or process to meet needs;

POC5. ability to understand the manufacturability, maintainability, and recyclability of engineering system and components;

POC6. ability to use modern engineering tools, techniques, and skills in engineering practice;

POC7. ability to communicate effectively;

POC8. ability to function in multi-disciplinary teams and provide leadership;

POC9. broadly educated with an understanding of the impact of engineering solutions on issues such as economics, business, politics, environment, health and safety, sustainability, and societal context;

POC10. clear understanding of professional and ethical responsibilities;

POC11. recognition of the need for life-long learning and continuing education;

POC12. international outlook with knowledge of contemporary issues.