COURSE OUTLINE

ELEC 215 – ELECTRICAL ENERGY CONVERSION

Prepared By: Dr. Rashid Aidun

May 2015
A. **TITLE**: ELECTRICAL ENERGY CONVERSION

B. **COURSE NUMBER**: ELEC 215

C. **CREDIT HOURS**: 4

D. **WRITING INTENSIVE COURSE**: NO

E. **WEEKS PER SEMESTER**: 15

F. **SEMESTER OFFERED**: Fall/Spring

G. **HOURS OF CLASS ACTIVITY**: 3- Hours Lecture and 3- Hours Laboratory per week

H. **CATALOG DESCRIPTION**: Fundamentals of Electricity, Magnetism, and Circuits related to generation of electrical power are discussed. The study of construction and operation of direct current generators and motors. The principles of operation of three phase induction motors and alternating current generators are presented. Topics also include linear motor and single phase motor principles and operation. Single phase transformer theory, and three phase circuits are also covered. Laboratory experiments are performed to reinforce the theory for each of the covered topics.

I. **PRE-REQUISITES/CO-COURSES**: Electric Circuits 2 (ELEC 102/129), or Electricity (ELEC 261) or permission of instructor.

J. **GOALS (STUDENT LEARNING OUTCOMES)**:

   By the end of this course, the student will be able to:

   - Describe how electrical power is generated.
   - Demonstrate hands-on experience in DC/AC Motors, and Generators.
   - Perform test on DC/AC Generators and Motors and analyze the result.
   - Prepare and deliver a technical presentation.
   - Single and multi-phase motors, and generators
   - Distinguish between True, Reactive, and Apparent power.

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<th>Course Objectives</th>
<th>Institutional SLO</th>
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<tr>
<td>a. Describe how electrical power is generated and distributed</td>
<td>1. Communication</td>
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<td>2. Critical Thinking</td>
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<td>b. Demonstrate hands-on experience in DC/AC Motors, and analyze transformer design</td>
<td>3. Professional Competence</td>
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<td>2. Critical Thinking</td>
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c. Troubleshoot transformers and motors

3. Professional Competence

d. Prepare and deliver a technical presentation

1. Communication

e. Perform test on electrical generators/motors, and analyze the result

3. Professional Competence
  2. Critical Thinking

K. TEXTS:


L. REFERENCES:


M. EQUIPMENT: All necessary Equipment is available.

N. GRADING SYSTEM: A-F

O. MEASUREMENT CRITERIA/METHODS:

Quizzes
Tests
Laboratory projects
Paper / Presentation.

P. DETAILED TOPICAL OUTLINE:

I. Energy in an Inductor/Capacitor, and Electromagnetism

II. Fundamentals of Mechanics and Heat
   A. Force
   B. Torque
   C. Power
   D. Power of Motor
   E. Transformation of Energy
   F. Efficiency of a Machine
   G. Speed of a Motor/Load system

III. Direct Current Generators
   A. Generating an ac voltage
   B. Converting ac to dc by commutation
   C. Difference between ac and dc generators
D. Induced voltage relationships
E. Characteristics of the generator under load
F. Shifting the brushes to improve commutation
G. Separately excited generator
H. Shunt generator
I. Load characteristics

IV. Direct Current Motors
A. Counter-electromotive force (cemf)
B. Mechanical Power and Torque
C. Speed Rotation
D. Armature speed control
E. Field speed control
F. Series motor
G. Shunt motor
H. Compound motor
I. Reversing the direction of rotation
J. Stopping a motor
K. Armature reaction
L. Flux distribution

V. Efficiency and Heating of Electrical Machines

VI. Active, Reactive, and Apparent Power
A. Instantaneous power
B. Active power
C. Reactive power
D. The capacitor and reactive power
E. Apparent power
F. Power factor
G. Power triangle

VII. Three-Phase Circuits
A. Delta & Wye connection
B. Balanced & Unbalanced Three-Phase loads
C. Three-Phase Power Calculation

VIII. The Ideal Transformers
IX. Practical Transformers
X. Equivalent Circuit of a Practical Transformer
XI. Autotransformers
XII. Three-Phase Induction Machines
A. Principle components
B. Principles of operation
C. The rotational field
D. Direction of rotation
E. Number of poles-synchronous speed
F. Starting characteristic of induction motors
G. Voltage and frequency induced in the rotor
H. Effect of rotor resistance on motor operation
I. Motor under load
J. Active power flow
K. Torque versus speed curve
L. Wound rotor & squirrel cage type induction machines
M. Properties of linear induction motors
N. Starting & plugging an induction motor
O. Doubly-Fed induction machines
P. Abnormal conditions
Q. Variable speed drives
R. Equivalent circuit of the induction machines

Q. LABORATORY OUTLINE

1. High voltage AC circuit measurements & calculations
2. Transformer Polarities
3. Step-down & step-up transformers
4. The Autotransformer
5. Direct Current Machine Characteristics
6. Direct Current Series Generators
7. Separately Excited Direct Current Shunt Generators
8. Self-Excited Direct Current Shunt Generators
9. Cumulative Compound Direct Current Generators
10. Differential Compound Direct Current Generators
11. The Direct Current Shunt Motor
12. The Direct Current Series Motor
13. The Direct Current compound Motor
14. Prime-Mover & torque measurements
15. Three-Phase circuits
16. The Wound Rotor Induction Motor
17. Split-Phase Induction Motor I & II
18. Characteristics of Squirrel cage type Induction Motor
19. Power Factor Correction for Induction Motors