



**Department of Electrical and
Computer Engineering**

**ECE 6614 PD: Industrial Utilization of Electrical Energy
Winter Term 2024**

COURSE INSTRUCTOR

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STUDY MATERIAL

- Lecture notes will be made available on the course web-site for download
- Other associated material (Assignments, research papers, etc.) will also be made available to participants

LECTURES

- There will be 12 lecture sessions in the course
- Lecture Session is 2 hours duration every Thursday from 2:00 pm-4:00 pm. There is also one office hour per week

EXAMINATION

- One written examination at the end of the course worth 70 % of the marks.
- Assignments for 30 % of the marks

OBJECTIVES

Extensive electricity utilization represents one of the hallmarks of a modern society. In this course, the basic concepts related to use of electric energy in various industrial applications and important issues related to such usage will be examined. The course also discusses issues related to economics of energy system usage and the concept of load management. The primary objective of the course is to provide students with the skills to understand the analytical methods and modern tools for solution of problems associated with utilization of electric energy in industrial sectors.

LEARNING OUTCOMES

- To clearly understand the basic concepts related to use of electric energy in various industrial, commercial and residential applications and important issues related to such usage.
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- To learn the analytical methods and modern tools for solution of problems associated with utilization of electric energy in industrial and commercial sectors.
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- To acquire the basic skills of how to approach and deal with real life situations and solve simple design and operation problems associated with energy utilization.
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- To learn how to deal with devices and systems for electric energy applications in various sectors and solve basic problems related to illumination, electric traction, heating and cooling, electrolysis, and economics of energy system usage.

TOPICS

1. Industrial Load Characteristics
2. Electrical Drives and Industrial Applications
3. Electric Traction
4. Electric Heating and Welding
5. Illumination Engineering
6. Electrolytic Processes
7. Economics of Electric Power Supply and Utilization
8. Industrial Power Factor Control
9. Demand Side Management

REFERENCE TITLES

1. C. L. Wadhwa, *Generation, Distribution and Utilization of Electrical Energy (3rd Revised edition), 2010*
2. E.R. Laithwaite and L. L. Freris, *Electric Energy: Its Generation, Transmission and User*, McGraw Hill Co., 1984.
3. C. O. Bjork, *Industrial Load Management - Theory, Practice and Simulations*, Elsevier, 1989
4. C.W. Gellings and S.N. Talukdar, *Load Management Concepts*, IEEE Press, 1986
5. *Lecturer Notes and Journal Papers*

PREREQUISITE

Basic understanding of electromagnetic energy conversion and power system engineering is required.

DETAILED PLAN

No. of Weeks	Topics	Sub-Topics
1	Industrial Load Characteristics	<ul style="list-style-type: none">- Classification of industrial loads- Load curves- Load characteristics- Load modeling- Mechanical Load Characteristics
2	Electrical Drives and Industrial Applications	<ul style="list-style-type: none">- Factors affecting selection of motors- Steady state and transient characteristics of drives- Size of motors and Load equalization- Drives for machine tools, lift and cranes, paper mills, printing machinery
1	Electric Traction	<ul style="list-style-type: none">- Electrical traction systems- Mechanical and electrical characteristics- Speed Curves- Mechanism of Train movement- Energy Consumption- Traction Motors- Traction Motor Control
1	Electric Heating and Welding	<ul style="list-style-type: none">- Advantages of electric heating- Heating methods- Power frequency heating:- High frequency heating:- Resistance furnace or oven- Dielectric heating- Frequency selection- Electric Welding
2	Illumination Engineering	<ul style="list-style-type: none">- Laws of illumination, Polar curves- Artificial sources of light.- Design of indoor and outdoor systems- Street lighting
1	Electrolytic Process	<ul style="list-style-type: none">- Principle of electro-deposition- Laws of electrolysis- Applications of electrolysis- Power supply for electrolytic processes
2	Economics of Electric Power Supply and Utilization	<ul style="list-style-type: none">- Economic Motive- Cost Analysis- Depreciation- Tariff for Electrical Energy- Economic Choice of Equipment

1	Industrial Power Factor Control	<ul style="list-style-type: none">– Causes of Low Power Factor– Advantages of Power Factor Improvement– Methods of Power Factor Improvement– Economics of Power Factor Equipment
2	Demand Side Management	<ul style="list-style-type: none">– DSM Benefits– DSM Actions– Integration of DSM Options in Supply Side– DSM Options and Supply-Side Resources– Integrated Resource Planning– Integrated Demand-Supply Planning– Demand-Side Screening Curve