POWER ENGINEERING
#01 - INTRODUCTION

2018

University of Glasgow

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Thanks to Mr Calum Cossar for most of the notes!!!

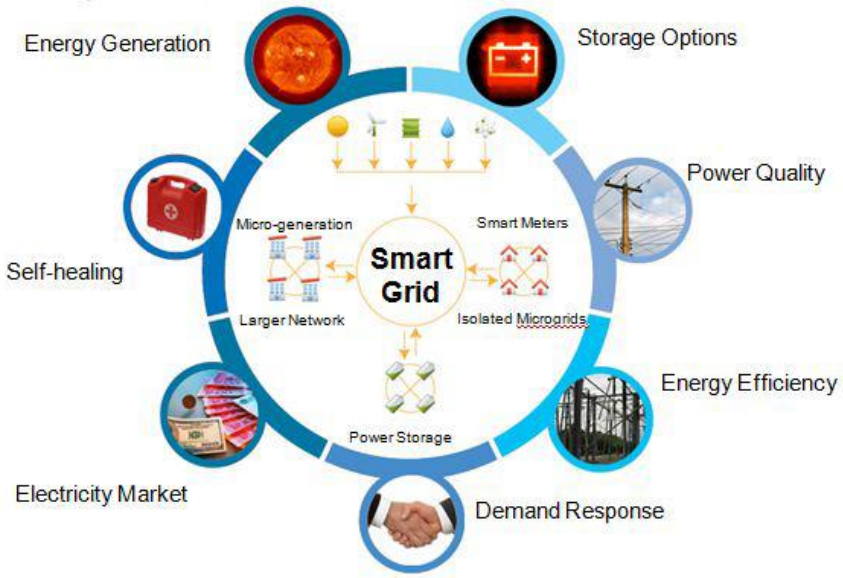
PLAN FOR TODAY

- Introduction to Power Eng 3 Course
- Introduction to Electrical Power Engineering

Course Aim

Over the last few years Electrical Power Engineering has seen a significant increase in demand, primarily through the increase in the development of renewable energy technologies. As a result there has been a significant increase in employment opportunities for graduates with the necessary skills/education

The Power Engineering course therefore aims to give E&EE students a relevant foundation in modern Electrical Power systems with emphasis where possible in renewable energy applications.



Keliang Zhou: Background/Research Interests

- **BEng, Huazhong University of Science and Technology1992**
- **PhD, Nanyang Technological University 2002**
- **Senior Lecturer, University of Glasgow, 2015 – present**
- **Research interests primarily associated with**
  - **Power electronic systems,**
  - **Control theory and applications,**
  - **Renewable energy and distributed generation,**
  - **Smart grid technologies**
- **One Monograph, about 120 co-author publications (about 60 journal articles) Total Citations about 4100, H-index:28**


ARCTIC OCEAN
ATLANTIC OCEAN
PACIFIC OCEAN
PACIFIC OCEAN
INDIAN OCEAN
AFRICA
SOUTH AMERICA
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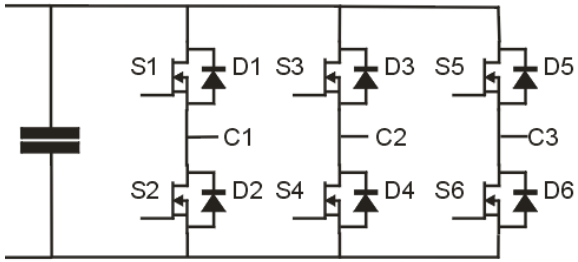
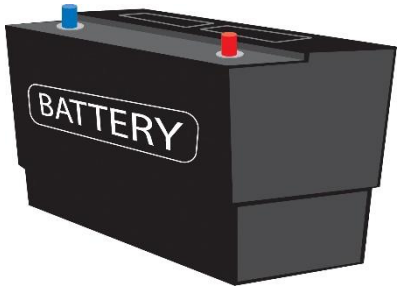
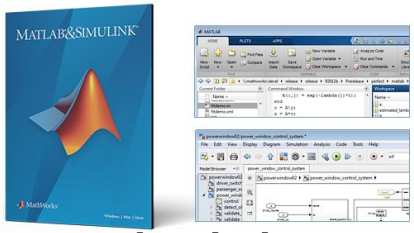
Technical Background

Power Electronic Converter



Control





Simulation

SUPERBUS

15000×2550×1
650mm
9500KG
300kW Electric
Drive
Li-ion Battery
Distance: 210km
250km/h
23 Passengers
Project since
2004

TU Delft
Delft University of Technology

XSAT MICRO-SATELLITE

LEICA SPRINTER DIGITAL LEVEL

Leica Geosystems

3 REASONS WHY YOU SHOULD CONSIDER A CAREER IN THE ELECTRICAL POWER INDUSTRY

- **Energy is one of the most important challenges facing mankind over the coming years. New power engineering technology will be required to provide solutions.**

- **Technical Diversity:**

  Power Engineering **Electro-Magnetics**

  Power Electronics **Digital Electronics**

  Control Theory **Mechanics**

  Thermo-dynamics **etc, etc**

- **Growing Industry NEEDs people with these skills**

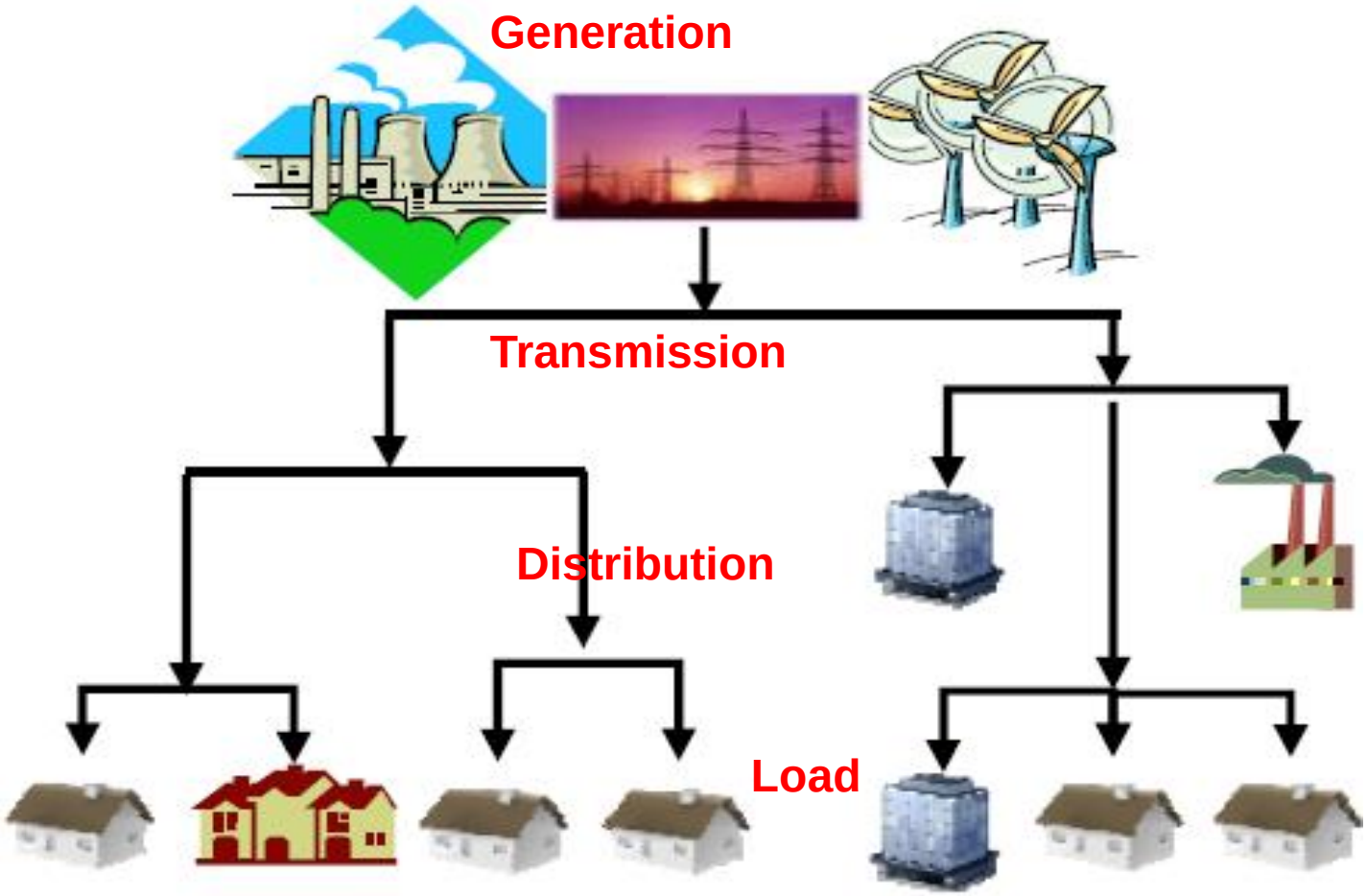
POWER ENGINEERING 3: COURSE OUTLINE

- 3 Weeks' Lectures/Tutorials
- 3 Laboratory Sessions (2 hours each)

Course Assessment

- 85%: Exam (2 hours)
- 15%: Laboratory

ELECTRICAL POWER SYSTEM



COURSE CONTENT

Electrical Generation (AC)

66kV

Step-Up Transformers

Transmission (AC)

138kV+

Step-Down Transformers

(AC) Loads

415V/240V

Coal Powered (2400MW)

Nuclear (1200MW)

Hydro-electric (400MW)

Wind (2MW)

1 & 3 Phase AC Power Systems

Rotating Machinery

Heating

Lighting

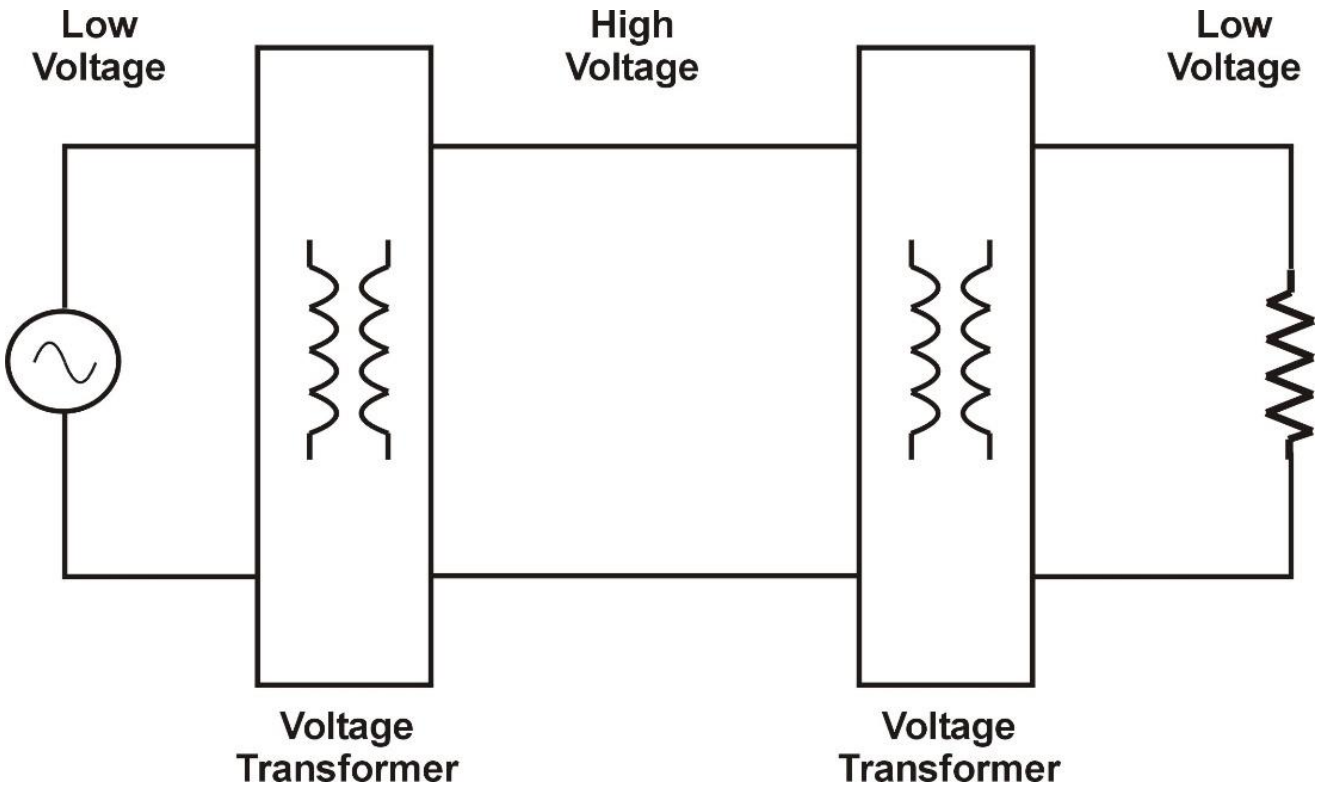
Synchronous Generator

Induction Generator

Induction Motor

ELECTRICAL POWER SYSTEM

IS ACTUALLY A BIG AC SINUSOIDAL CIRCUIT



Topics	
1	**Introduction:** DC v AC Systems Fundamentals of AC systems
2	**Single & Three Phase Systems:** R,L & C Loads Phasor Diagrams Power Triangle Balanced/Unbalanced 3 Phase Loads Power Measurement
3	**Transformers:** Magnetics Ideal/Real Transformer Equivalent Circuit No Load & Short Circuit Tests Three Phase Transformers
4	**3 Phase Induction Motors:** Construction Theory of Operation Equivalent Circuit No Load & Locked Rotor Tests Variable Speed Operation
5	**3 Phase Synchronous Generators:** Construction Theory of Operation Equivalent Circuit Modes of Operation Safe Operating Area
6	**Exam Preparation**

RESOURCES

what will help you pass the exam?

- **Laboratory Sessions**
- **BlackBoard Website**
- **Recommended Readings**
- **Tutorials**

Power Eng 3: Laboratory Sessions

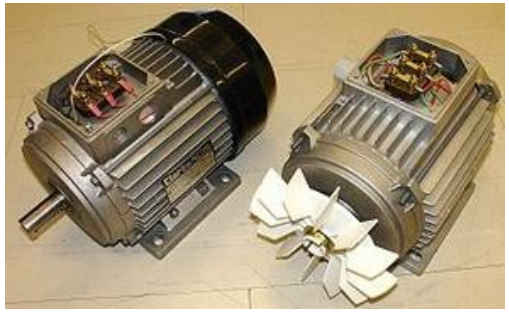
1 & 3 Phase Power Systems

- Voltage, Current and Power Factor measurements
- Real, Apparent and Reactive power measurements
- 3 phase power systems: Delta and Wye connected loads

Transformers

- No load and Short circuit tests to determine equivalent circuit parameters
- Voltage Regulation from no load to full load
- Efficiency measurements

3 Phase Induction Motor



- No load and locked rotor tests to determine equivalent circuit parameters
- Torque v Speed, and efficiency measurements
- Comparison with simulation results

Where do the Laboratory Sessions take place?

- Research Building Laboratory 330 (Next to Power Electronics Lab)

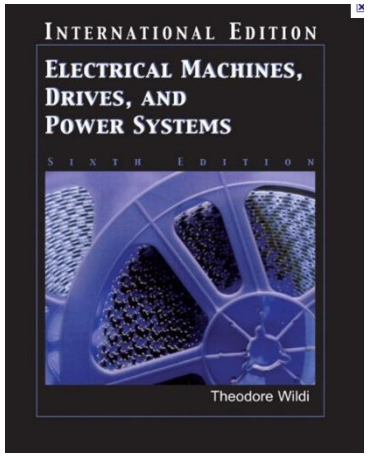
What do you NEED to bring?

- Printed Lab Sheets and Bound Laboratory record book
- Pen and pencil (and erazor)
- Ruler and protractor
- Calculator

How are the Laboratory Sessions Assessed?

- Laboratory Book (submitted at the end of the semester)

Power Eng 3: Recommended Reading

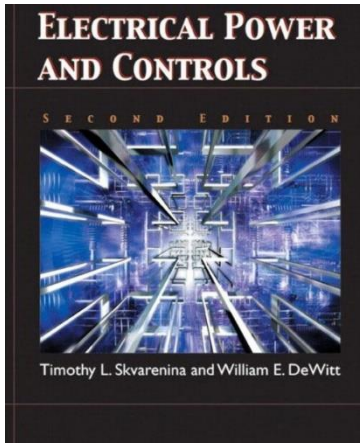


Electrical Machines, Drives & Power Systems

Theodore Wildi

Pearson Publishing

ISBN 0-13-196918-8



Electrical Power and Control

Timothy Skvarenina, William DeWitt

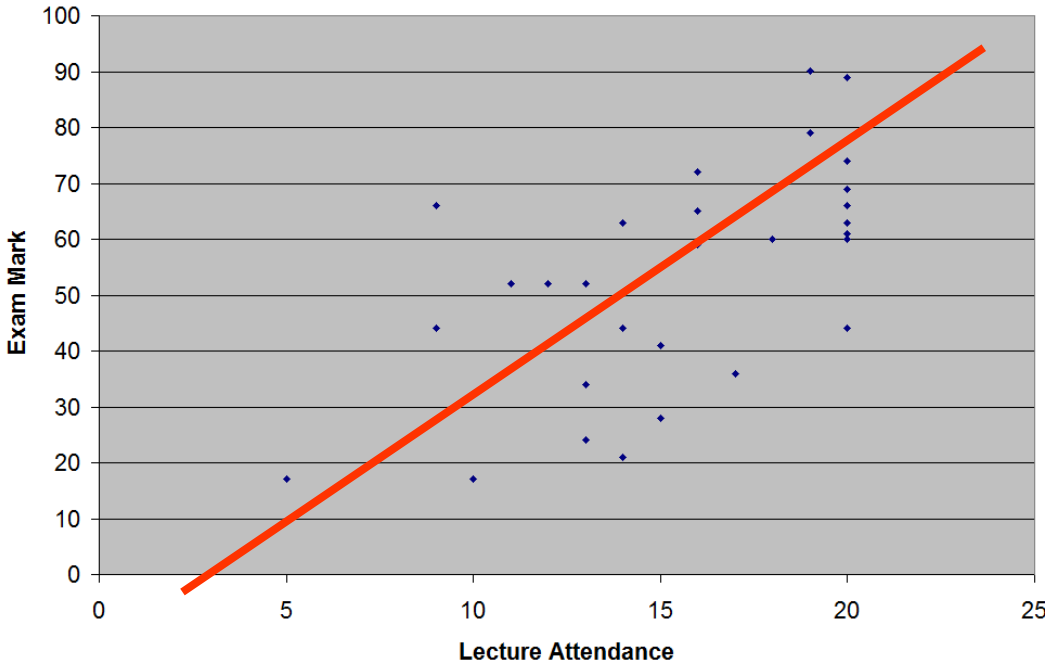
Pearson Publishing

ISBN 0-13-113045-5

Now the BAD News!

What I expect of YOU

what I expect of YOU!



Unsurprisingly there is a clear ('linear') correlation between Lecture attendance and Exam Marks

- **I will record attendance at every lecture**
- **Arrive on time**
- **Keep noise levels to a minimum during lectures**

Solution done on whiteboard during lecture

Be Warned

a lot of these appear throughout the course

Your Route to getting a Credit for this course:

- **You MUST attend at least 50% of the lectures/tutorials**
- **You MUST attend all 3 laboratory sessions and submit your individual laboratory report at the end of the semester**
- **You must gain a sufficiently high grade in the Final exam**