MATLAB based Methodology for Teaching Technical Subjects

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Characteristics of 21st Century Teacher & Engineering Education

Role of Modern Tools in Learning Electrical Engineering

Examples from Subjects: “Control Systems” & “Electrical Measurements and Measuring Instruments”

Effect of using Modern Tools & Mapping them to Graduate Learning Attributes
Characteristics of a 21st Century Teacher

- Student Centric Classroom
- Digital Presence
- Project based learning
- Use of Technology
- Innovate
- Learning and adapting

Use of Modern Tools

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Engineering Education

• Understanding of technical concept with **practical understanding** is highly relevant.

• Based on **practice minimums** gained in labs during the university education.
The cost and comprehensiveness of the lab equipment has increased in the past few years.
Role of Modern Tools in Engineering Education

Turns a regular PC into a Virtual Lab.

Balance between virtual and real labs,

• Optimize cost problems,
• Enough practice for graduating engineers

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Learning through Modern Tools

The use of modern tools enhances the understanding of concepts.

Virtual experiments are better equipped to understand due to use of

• Mathematical expressions
• Graphics, effectively.
Modern Tools in Electrical Engineering

- LabVIEW - Laboratory Virtual Instrument Engineering Workbench
- PSCAD - Power System Computer Aided Design
- ETAP - Electrical Transient and Analysis Program
- MATLAB/SIMULINK

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MATLAB® / Simulink®

- **MATLAB** (Matrix Laboratory) is a multi-paradigm numerical computing environment.
- **Simulink** is a graphical programming environment for modelling, simulating and analysing multi-domain dynamic systems.

® Mathworks
Create Learning Tool using MATLAB

Steps for Teacher

1. Develop the model for the problem and build a Graphical User Interface (GUI) for it in MATLAB.
2. Create a self-extracting package for the GUI using “deploytool”.
3. Distribute the package to the students.

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Create Learning Tool using MATLAB

Load MATLAB Runtime Environment (Freely available)

Double-click the self-extracting package.

Experiment & Learn

Steps for Student

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Example #1
Control Systems

- Systems and their representation
- Time Response Analysis
- Frequency Response Analysis
- Stability of Control System

Syllabus Contents

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Example #1
Control Systems

Learning Outcomes:

Understanding of the fundamentals of control systems.

Determine and use models of physical systems in forms suitable for use in the analysis and design of control systems.

Determine the time and frequency-domain responses of systems to various inputs.

Determine the stability of a closed-loop control system.
Example #1
Control Systems

Time Response Analysis

P, PI, PID MODES

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P-Control Problem

- $K_P = \text{Variable Gain}$
- $\text{Plant} = \frac{1}{(s^2 + 10s)}$
- $\text{Feedback} = 1$
- $\text{Transfer Function} = \frac{K_P}{(s^2 + 10s + K_P)}$
P-Control Problem

Image from Wikipedia

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Demo

Understanding P - mode of Feedback Control

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Example #2
Electrical Measurements & Measuring Instruments

- Units, Standards & Errors, Measuring System Fundamentals
- Measuring Instruments
- Wattmeters & Energy Meters, Power Factor & Frequency Meters
- Low & High Resistance Measurements, A.C. Bridges

Syllabus Contents

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Example #2
Electrical Measurements & Measuring Instruments

Learning Outcomes:

Understand the units and standards followed in the industry

Gain knowledge of fundamentals of measuring instruments

Understanding working and functions of equipment used for measuring electrical quantities

Understand the basics of resistance measurements and bridge – based measurements

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Example #2
Electrical Measurements & Measuring Instruments

Low & High Resistance Measurements, A.C. Bridges

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De-Sauty’s Bridge

\[ C_1 = C_2 \times \frac{R_2}{R_1} \]
Demo

Understanding De-Sauty’s Bridge

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For which concept tool could be developed?

Mathematical Formulation

Learning Tool could be developed

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## Effect of Modern Tools

<table>
<thead>
<tr>
<th>Enhances the involvement of the students in learning process.</th>
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<tr>
<td>Improves students’ understanding of the concept.</td>
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<td>Students get enough practice that is required and is relevant for engineering</td>
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<td>Students are able to test the learning of technical concepts.</td>
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Graduate Learning Attributes

- Engineering Knowledge
- Problem Analysis
- Design and development of solution
- Modern Tool usage
Conclusion

Outcome based education is important to make our education system valuable in real terms.

This requires teachers from technical education to deliver content through innovative practices and with the use of modern technology & tools to achieve the course outcome.

Through this webinar, we have demonstrated the use of MATLAB as modern tool for the achievement of the graduate attributes.

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References

Thank You.

Queries and Discussion

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