

Cambridge **TECHNICALS LEVEL 3**

ENGINEERING



**A PROJECT APPROACH TO DELIVERY – WIND TURBINE
CONTROL**

RESOURCE LINKS

Version 2

The Siemens logo, consisting of the word 'SIEMENS' in a bold, teal, sans-serif font, set against a white rectangular background.

SIEMENS

INTRODUCTION

Resources Link is an e-resource, provided by OCR, for teachers of Cambridge Technicals in Engineering. It provides descriptions of, and links to, a variety of teaching and learning resources that you may find helpful.

Where appropriate, we have mapped these resources to this OCR unit and Learning Outcomes (LOs), and provided information about their cost and format.

If you know of other resources you would like to see included here, or discover broken links, please let us know. We would also like to hear from you if you have any feedback about your use of these, or other, OCR resources. Please contact us at resources.feedback@ocr.org.uk

To find out more about this qualification please go to: <http://www.ocr.org.uk/qualifications/cambridge-technicals-engineering-level-3-certificate-extended-certificate-foundation-diploma-diploma-05822-05825/>

TYPES OF RESOURCE

OCR Produced Resources

These are resources devised and produced directly by the Resources Development Team at OCR.

Publisher Partner Resources

For many subjects OCR works with a publisher partner to ensure that good quality resources such as textbooks are available for first teaching.

Whilst the publisher partner has access to our subject experts and we quality check and endorse these resources they are produced by, and remain the property of, the publisher partner. There is no financial link between OCR and its publisher partners and we do not pay for the development of, or receive any royalties from, these resources.

Endorsed Resources

These resources were produced entirely independently of OCR, but we have quality checked them for their suitability as a resource to support our qualifications.

Other Resources

Unless specifically stated these resources are completely independently produced and are not endorsed by OCR. We have looked at them though, and we think they could be useful in supporting our specifications.

We leave it to you, as a professional educator, to decide if any of these resources are right for you and your students, and how best to use them.

LINKS

The three links below show examples of working models of wind turbines.

Automation and Control

A YouTube link of a prototype model wind turbine control system showing one approach to altering blade pitch to compensate for varying wind conditions.

Supports: Automation and Control Pathway

Cost: Free

Format: URL to YouTube web link

https://www.youtube.com/watch?v=gauz9nDBOcw&feature=em-share_video_user

Automation and Control

A YouTube link of a prototype model wind turbine control system showing one approach to altering blade pitch to compensate for varying wind conditions.

Supports: Automation and Control Pathway

Cost: Free

Format: URL to YouTube web link

https://www.youtube.com/watch?v=wyhyEc-leTw&feature=em-share_video_user

Automation and Control

A YouTube link of a prototype model wind turbine control system showing how altering blade pitch to compensate for varying wind conditions is controlled remotely using a servo motor.

Supports: Automation and Control Pathway

Cost: Free

Format: URL to YouTube web link

https://www.youtube.com/watch?v=MAtNkeF0VR0&feature=em-share_video_user

Siemens – Blowing in the Wind/e-Zero Island

A suite of sustainable engineering resources for teachers, including ones relating to the use of renewable resources to generate electricity. Has learning activity directly relevant to wind turbines. E-Zero Island is an interactive modelling system demonstrating energy transfer and sustainable energy.

Supports: A Project Approach to Delivery – Wind Turbine Control

Cost: Free

Format: Web page

<http://www.siemens.co.uk/education/en/teachers/teaching-resources/schemes-of-work-ks3.htm>

Siemens Living Energy e-magazine

An e-magazine dedicated to energy leadership. Includes articles relating to energy generation by wind turbine.

Supports: A Project Approach to Delivery – Wind Turbine Control

Cost: Free

Format: Web page

<http://www.energy.siemens.com/br/en/energy-topics/publications/living-energy/>

Siemens – Sustainable Energy

Website presenting Siemens products and solutions for sustainable energy generation and management.

Supports: A Project Approach to Delivery – Wind Turbine Control

Cost: Free

Format: Web page

<http://www.energy.siemens.com/hq/en/sustainable-energy/>

Siemens – Wind Power Solutions

A website presenting Siemens on-shore and off-shore wind generation solutions and projects.

Supports: A Project Approach to Delivery – Wind Turbine Control

Cost: Free

Format: Web page

<http://www.energy.siemens.com/hq/en/renewable-energy/wind-power/>

Wind Turbine Technology

Comprehensive set of teaching resources related to the design and operation of wind turbines.

Supports: A Project Approach to Delivery – Wind Turbine Control

Cost: Free

Format: Web page

<http://www.sciencetechnologyaction.com/lesson/wind-turbine-technology>

The Inside of a Wind Turbine

Brief introduction about the components and operation of a wind turbine.

Supports: A Project Approach to Delivery – Wind Turbine Control

Cost: Free

Format: Web page

<http://energy.gov/eere/wind/inside-wind-turbine-0>

Siemens 360°

Harvesting the wind, explore the innovative machinery behind the scenes and learn more.

Supports: A Project Approach to Delivery – Wind Turbine Control

Cost: Free

Format: Web page

<http://www.siemens.com/innovation/pool/features/siemens360/wind-power/>

Wind Turbine Design Lecture Video

Design principles of Wind Turbine blades, blade length, tower height and number of blades are explained elaborately in this animated video lecture.

Supports: A Project Approach to Delivery – Wind Turbine Control

Cost: Free

Format: YouTube Video

<http://www.youtube.com/watch?v=p5k2LhKBSgQ>

Mini Wind Turbine

Example mini turbine project.

Supports: A Project Approach to Delivery – Wind Turbine Control

Cost: Free

Format: Web page

<http://www.popularmechanics.com/science/environment/how-to/g118/make-your-own-miniature-wind-turbine/?slide=6>

Control Systems – Open and Closed Loop

Series of tutorials explaining open and closed loop control theory.

Supports: A Project Approach to Delivery – Wind Turbine Control

Cost: Free

Format: Web page

<http://www.electronics-tutorials.ws/systems/closed-loop-system.html>

Sensors and transducers

Good introduction to sensors and transducers. Includes details of signal conditioning and scaling.

Supports: A Project Approach to Delivery – Wind Turbine Control

Cost: Free

Format: Web page

http://www.electronics-tutorials.ws/io/io_1.html

Wind speed sensor – anemometer

Description of a commercial anemometer wind speed sensor with voltage output. Includes data sheets. Suitable for connecting to embedded and PLC-based systems with A to D converter.

Supports: A Project Approach to Delivery – Wind Turbine Control

Cost: Free

Format: Web page

<http://www.adafruit.com/products/1733>

Speed sensor (tachogenerator)

An explanation of the tachogenerator – including reference to calibration graphs. Explains the principle by which the anemometer works.

Supports: A Project Approach to Delivery – Wind Turbine Control

Cost: Free

Format: Web page

<http://www.tachogeneratorsguide.com/whatis.html>

Sensor interfacing

Good introduction to sensor interfacing techniques including scaling.

Supports: A Project Approach to Delivery – Wind Turbine Control

Cost: Free

Format: Web page

http://www.sensorwiki.org/doku.php/tutorials/basic_sensor_interfacing_techniques

Analogue to Digital (A to D) and Digital to Analogue (D to A) conversion

An explanation of the purpose of A to D and D to A converters, and how they can be achieved using a summing op amp circuit.

Supports: A Project Approach to Delivery – Wind Turbine Control

Cost: Free

Format: Web page

http://www.allaboutcircuits.com/vol_4/chpt_13/1.html

Electric linear actuator

A manufacturer's website showing a range of electric linear actuators.

Supports: A Project Approach to Delivery – Wind Turbine Control

Cost: Free

Format: Web page

http://www.techdrives.co.uk/linear_actuators.html

Electric rotary actuator (servo motor)

An explanation of the servo motor and its application as a rotary actuator.

Supports: A Project Approach to Delivery – Wind Turbine Control

Cost: Free

Format: Web page

<http://www.electrical4u.com/servo-motor-servo-mechanism-theory-and-working-principle/>

Microprocessor and microcontroller architecture

A comparison of the architecture between the microprocessor and microcontroller.

Supports: A Project Approach to Delivery – Wind Turbine Control

Cost: Free

Format: Web page

<http://www.electronicshub.org/difference-between-microprocessor-and-microcontroller/>

Raspberry Pi

Website for the Raspberry Pi computer. Includes many resources.

Supports: A Project Approach to Delivery – Wind Turbine Control

Cost: Free

Format: Web page

<http://www.raspberrypi.org/>

PiFace – interfaces for the Pi

Low-cost interfaces that enable connection with the Raspberry Pi in order to develop control systems (with inputs and outputs).

Supports: A Project Approach to Delivery – Wind Turbine Control

Cost: Free

Format: Web page

<http://www.piface.org.uk/>

Microchip PIC microcontrollers

Official Microchip website – manufacturer of the PIC microcontroller. Includes many free downloadable resources. The PIC is a low cost embedded system.

Supports: A Project Approach to Delivery – Wind Turbine Control

Cost: Free

Format: Web page

<http://www.microchip.com/>

Arduino – embedded devices

Official Arduino website for the Arduino microcontroller. Includes many free downloadable resources and tutorials. The Arduino is a low cost embedded system.

Supports: A Project Approach to Delivery – Wind Turbine Control

Cost: Free

Format: Web page

<http://www.arduino.cc/>

Introduction to PLCs

An introduction to PLCs, and programming in ladder logic.

Supports: A Project Approach to Delivery – Wind Turbine Control

Cost: £8.50 approx

Format: Paperback Book

http://www.amazon.co.uk/Introduction-PLCs-beginners-Programmable-Controllers/dp/061565438X/ref=sr_1_4?ie=UTF8&qid=1421566627&sr=8-4&keywords=introduction+to+ladder+logic

PLC (programmable logic controller)

A block diagram of the internal architecture of a PLC.

Supports: A Project Approach to Delivery – Wind Turbine Control

Cost: Free

Format: Web page

<http://www.ti.com/solution/programmable-logic-controller-diagram>

Siemens – Simatic PLC Controllers

Resources for the Siemens Simatic range of Programmable Logic Controllers (PLCs). Discounted educational packages are available for some PLCs in the range.

Supports: A Project Approach to Delivery – Wind Turbine Control

Cost: Free

Format: Web page

<http://w3.siemens.com/mcms/programmable-logic-controller/en/pages/default.aspx>

Siemens Automation – support for education

Siemens website with automation and control resources for educators. Includes online training and educational resources, and also resources to download.

Supports: A Project Approach to Delivery – Wind Turbine Control

Cost: Free

Format: Web page

<http://w3.siemens.com/mcms/sce/en/pages/default.aspx>

Introduction to Ladder Diagrams

Ladder and digital logic basics for beginners.

Supports: A Project Approach to Delivery – Wind Turbine Control

Cost: Free

Format: Web page

<http://www.allaboutcircuits.com/textbook/digital/chpt-6/ladder-diagrams/>

Software Testing

A tutorial covering procedures for testing software. Shows how to develop a simple software test plan.

Supports: A Project Approach to Delivery – Wind Turbine Control

Cost: Free

Format: Web page

http://www.teach-ict.com/as_a2_ict_new/ocr/A2_G063/331_systems_cycle/testing/miniweb/pg6.htm

Four levels of software testing

A tutorial explaining the four levels of software testing: unit testing, integration testing, system testing and acceptance testing.

Supports: A Project Approach to Delivery – Wind Turbine Control

Cost: Free

Format: Web page

<http://reqtest.com/testing-blog/differences-between-different-test-levels/>

Statistical Process Control (SPC)

A basic introduction to SPC. Web site also has free software that be downloaded (trial version).

Supports: A Project Approach to Delivery – Wind Turbine Control

Cost: Free

Format: Web page and free trial software download (60 days)

<http://www.winspc.com/what-is-spc>

SPC – moving average charts

A guide to producing and interpreting SPC moving average charts (sometimes termed individual-X moving average charts).

Supports: A Project Approach to Delivery – Wind Turbine Control

Cost: Free

Format: Web page

http://qualityamerica.com/LSS-Knowledge-Center/statisticalprocesscontrol/individual-x_moving_range_charts.php

Siemens – Human Machine Interface

A set of resources relating to the Siemens Sematic Human Machine Interface (HMI).

Supports: A Project Approach to Delivery – Wind Turbine Control

Cost: Free

Format: Web page

<http://w3.siemens.com/mcms/automation/en/human-machine-interface/Pages/Default.aspx>

Expert System – Wind Turbine gearbox

An academic paper showing how an expert system can be used to inform maintenance of a wind turbine gearbox. The paper is relatively easy to follow.

Supports: A Project Approach to Delivery – Wind Turbine Control

Cost: Free

Format: Web page

<http://www.sciencedirect.com/science/article/pii/S2211381911002189>



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