

NATIONAL METAL & ENGINEERING CURRICULUM

1. Module details

Module name	Power Control Systems
Nominal duration	Half module It is anticipated that a student possessing the skills and knowledge developed in the prerequisites will achieve the module purpose in 18 to 20 hours.
Module code	NE185
Discipline code	0703205

2. Module purpose

To enable students to understand the specifications, principles of operation and applications of power control circuits, in particular those based on SCRs and TRIACs.

3. Prerequisites

DC Power Supplies (NE178)

4. Relationship to competency standards

This module provides some of the knowledge and skills underpinning competence in the following standards.

Federal Metals Industry Award Standards, Unit 18.56A.

Electrical Contracting Industry Award Standards
Electrical Stream Units 5.5, 5.6, 5.7
Electronic Stream Units 5.4, 5.5, 5.6, 5.7

5. Content

Summary of content

1. Typical power control applications.
Heaters, soldering irons, stove elements, lamp dimmers, motor speed controllers etc.).
Methods of power control and phase angle control.
Pulsed Power Control:
 - bimetal thermostat heaters
 - half-wave/full-wave control (duo temperature soldering irons)
 - series resistor control (continuously variable).
2. Power control devices, symbols and specification and in-circuit operation.
Operation of typical half-wave and full-wave power control circuits.
Limitations of phase angle control and noise reduction methods.
Fault finding and safety problems.

6. Assessment strategy

Assessment method

Written tests
Assignments
Practical exercises

Conditions of assessment

Normally learning and assessment will take place in a classroom/laboratory environment.

7. Learning outcome details

On completion of this module the learner will be able to:

Learning outcome 1

Describe typical systems that require power control.

Assessment criteria

- 1.1 List typical power control applications.
- 1.2 Distinguish between slow On/Off and fas phase angle power control. (In terms of average temperature and lamp brightness effects).

Learning outcome 2	Explain the concept of power control.
Assessment criteria	<p>2.1 Describe the operation of simple power control systems.</p> <p>2.2 State the efficiency problem associated with series resistor control.</p> <p>2.3 State the need for smooth, continuous control of power (as in a lamp dimmer) to avoid flicker problems.</p>
Learning outcome 3	Explain the concept of phase angle control with reference to a sinusoidal waveform.
Assessment criteria	<p>3.1 Sketch a sinusoidal voltage waveform showing half-power and full-power operation.</p> <p>3.2 Explain the concept of variable phase angle power control for half and full-wave conduction.</p>
Learning outcome 4	Explain the characteristics and operation of SCRs and TRIACs and show how they can be used to obtain phase angle power control.
Assessment criteria	<p>4.1 Draw the circuit symbols and label the terminals of SCRs and TRIACs.</p> <p>4.2 Sketch typical current-voltage characteristics of SCRs and TRIACs.</p> <p>4.3 Describe blocking and conducting states, switch-off characteristics and the gate triggering requirements of SCRs and TRIACs and state their limitations.</p> <p>4.4 Explain how SCRs and TRIACs can be used to obtain phase angle power control in conjunction with a sinusoidal voltage supply.</p>

Learning outcome 5	Explain the operation of typical full-wave variable conduction angle power controllers used in lamp dimmers.
Assessment criteria	<p>5.1 Identify the main current circuit and the gate control circuit.</p> <p>5.2 Explain the operation of the gate voltage phase delay circuit and the generation of pulsed gate current.</p> <p>5.3 Identify the RF suppression circuit associated with the power controller and state the reason for its inclusion.</p> <p>5.4 List the high voltage hazards associated with mains power controllers.</p> <p>5.5 Measure and sketch the input and output voltage waveforms and explain the relationship between load power and conduction angle.</p>
Learning outcome 6	Explain the operation of SCR power controllers and methods of obtaining full-wave power control.
Assessment criteria	<p>6.1 State the limitations of TRIACs (lower power) and SCRs (unidirectional conduction).</p> <p>6.2 Explain the operation of typical SCR power control circuits specifically in allowing bi-directional or full-wave load current flow.</p>
Learning outcome 7	State the limitations of phase angle power control and explain the methods used to counter them.
Assessment criteria	<p>7.1 Explain EMI generation by rapid rise time wavefronts.</p> <p>7.3 Explain how the use of zero-crossing switching limits EMI generation and describe the limitations this has, with reference to pulsed or ON/OFF control systems</p>

Delivery strategy

Delivery strategies selected must be suitable for both theoretical and/or practical learning outcomes and must reflect the availability of equipment and the needs of the client.

It is recommended that learning and assessment be facilitated in a holistic manner which may require a learning sequence other than indicated in the body of this module.

Resource requirements

Useful references include:

Bell, David A. 1986, *Electronic Devices and Circuits*, 3rd edition, Prentice Hall.

Occupational health and safety requirements

A safe and healthy environment will be provided for students in regards to classroom and laboratory safety.