

# NATIONAL METAL & ENGINEERING CURRICULUM

## 1. Module details

<b>Module name</b>	<b>Temperature</b>
<b>Nominal duration</b>	One module It is anticipated that a student holding the prescribed entry skills will achieve the module purpose in 35 to 40 hours.
<b>Module code</b>	NI205
<b>Discipline code</b>	0703325

## 2. Module purpose

This module aims to provide the student with the knowledge and skills in the operation, selection and fault diagnosis of common temperature primary elements and measurement systems.

## 3. Prerequisites

Concepts of Instrumentation (NI201)

## 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 18.62A.  
  
Electrical Contracting Industry Award Standards  
Instrument Stream Units 5.4, 5.5, 5.6, 5.7, 5.8

## 5. Content

### Summary of content

1. Heat and temperature  
Differentiation between heat and temperature, SI and non-SI temperature scales and units and conversions between scales.
2. Non-electrical thermometers  
The principles of operation characteristics and construction of liquid-in-glass, bi-metallic and filled system thermometers.

3. **Electrical thermometers**  
The laws and effects associated with electrical temperature primary elements. The principles of operation, characteristics and construction of thermometers, resistance thermometers (RTDs), thermistors, and semiconductor and integrated circuit thermometers. Compensation and protection devices and associated measuring circuits. Circuit connections for average temperature and temperature differences should also be examined regarding installation and measuring circuit considerations which vary from the norm.
4. **Radiation thermometers**  
The laws governing radiation thermometers and the properties of a 'Black Body'. The theory of operation, characteristics and construction of disappearing filament, partial radiation and total thermometers.  
Total and spectral emissivity.
5. **Other measurement techniques**  
The operation and characteristics of pyrometric cones, temperature sensitive pigments and liquid crystals.  
(Brief mention only).
6. **Test equipment**  
The theory of operation, operation and use of Wheatstone bridges, millivolt potentiometers and other test equipment associated with temperature measurement.
7. **Errors**  
The errors specific to temperature measurement. These include: thermal lag, frictional heating conductive cooling and cavitation.

## **6. Assessment strategy**

### **Assessment method**

Short-answer tests  
Practical exercises

### **Conditions of assessment**

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

<b>7. Learning outcome details</b>	On completion of this module the learner will be able to:
<b>Learning outcome 1</b>	Define the terms associated with temperature and other heat-related phenomena.
<b>Assessment criteria</b>	<ul style="list-style-type: none"> <li>1.1 Differentiate between heat and temperature.</li> <li>1.2 Define the terms associated with temperature and other heat related phenomena.</li> </ul>
<b>Learning outcome 2</b>	Convert temperatures between scales.
<b>Assessment criteria</b>	<ul style="list-style-type: none"> <li>2.1 List the units commonly used in temperature measurement.</li> <li>2.2 Convert between Imperial and SI units.</li> <li>2.3 Explain the purpose of the fixed points outlined in the International Practical Temperature Scale.</li> </ul>
<b>Learning outcome 3</b>	Explain the operation of the primary elements and measuring elements covered.
<b>Assessment criteria</b>	<ul style="list-style-type: none"> <li>3.1 State the principles of operation and characteristics of the various temperature sensors and measuring systems.</li> <li>3.2 Explain the operation of the temperature measuring systems covered in the 'OUTLINE OF CONTENT'.</li> <li>3.3 Explain the operation of the various compensation and protection devices utilised in temperature measuring systems.</li> <li>3.4 Explain the techniques used for the measurement of temperature average and temperature difference using the various types of electrical thermometers.</li> </ul>

<b>Learning outcome 4</b>	Demonstrate proficiency in installing, repairing and calibrating temperature measuring systems.
<b>Assessment criteria</b>	<ul style="list-style-type: none"> <li>4.1 Install/maintain various temperature measuring/transmitting systems.</li> <li>4.2 Identify thermocouple extension/compensating cable materials and polarities by colour codes and physical characteristics.</li> <li>4.3 Determine the most suitable thermowell for a given installation.</li> <li>4.4 Calibrate temperature system of optimum performance.</li> </ul>
<b>Learning outcome 5</b>	Select the appropriate measuring system for given applications.
<b>Assessment criteria</b>	<ul style="list-style-type: none"> <li>5.1 Select an appropriate temperature measuring system for a given application.</li> <li>5.2 List those considerations which determine the use of a particular temperature measuring system.</li> </ul>
<b>Learning outcome 6</b>	Explain the operation of, and demonstrate the correct use of test equipment used in temperature measurement.
	<ul style="list-style-type: none"> <li>6.1 Explain the operation of the various test equipment used with temperature measurements.</li> <li>6.2 Use temperature calibration test equipment correctly.</li> </ul>
<b>Learning outcome 7</b>	Define the errors specific to temperature measurement.
	<ul style="list-style-type: none"> <li>7.1 Define the errors specific to temperature measurement.</li> <li>7.2 Outline appropriate measures to reduce measurement errors.</li> </ul>

## 8. Delivery of the module

### Delivery strategy

Delivery strategies must be suitable for both theoretical and/or practical learning and module purpose.

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

Also an integrated theory/practice approach should be used where students learn by experimentation and through research and laboratory reports.

### Resource requirements

To complete this module students will need access to sufficient measurement, test and signal generation equipment to allow each student to undertake individually the practical and assessment tasks.

Useful references include:

Bolton, W. 1991, *Instrumentation and Process Measurements*, Longman Group UK Limited.

Jones, E.B. 1985, *Jones' Instrument Technology*, Vols. 1 and 2, 4th edition, Butterworths, Borough Green, England.

Considine, D.M. 1985, *Process Instruments and Controls Handbook*, 4th edition, McGraw-Hill, New York.

Anderson, N.A. 1980, *Instrumentation for Process Measurement and Control*, 3rd edition, Chilton Company, Adnor, Pennsylvania.

Johnston, C. 1993, *Process Control Instrumentation*, 4th edition, Regents/Prentice Hall, Englewood Cliffs, New Jersey.

### Occupational health and safety requirements

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