Cork Institute of Technology
Higher Certificate in Engineering in Mechanical Engineering – Stage 1
(National Certificate in Engineering in Mechanical Engineering – Stage 1)
(NFQ – Level 6)
Autumn 2005
ELECTROTECHNOLOGY & INSTRUMENTATION
(Time: 3 Hours)

Answer FIVE questions, at least TWO from each Section.
All formulae and calculations must be shown.

Examiners: Mr. R. Simpson
Mr. J. Connolly
Mr. S. Cotter

Section A (Electrotechnology)

1. (a) Define or explain the terms: potential difference and electromotive force. (6 marks)
(b) A cell of emf 2 volts and internal resistance of 0.2 ohms is connected into a circuit containing a resistance 1 ohm in series with a lamp bulb of resistance 2 ohms for 30 minutes. Calculate the circuit current, the p.d. across the bulb, and the energy consumed by the bulb during this period. (14 marks)

2. (a) State the Laws of Electrolysis & also state the main industrial applications of electrolysis. (10 marks)
(b) What mass of copper is deposited onto the cathode by a current of 10 A flowing for one hour in an electrolysis cell consisting of copper electrodes and copper sulphate solution?
The electrochemical equivalent for copper is 3.29 x 10^-7 kg / C. (10 marks)

3. (a) Describe how a galvanometer may be converted into an ammeter. (8 marks)
(b) A galvanometer with full-scale deflection (f.s.d.) of 2.00 mA and coil resistance 70 Ω is to be used as an ammeter to read up to 5 A.
What maximum value of shunt resistance is required? (12 marks)

4. Describe the construction and operation of an industrial version of the Potentiometer circuit as an accurate method for the measurement of potential difference.
Section B (Measurement & Instrumentation)

5. (a) Define or explain, with the aid of diagrams and examples, the meaning of the following measurement terms: accuracy, precision, range, span, and resolution.  

(10 marks)

(b) Define or explain, with the aid of diagrams and examples, the meaning of the following calibration-type errors: zero error, proportionality error, maximum non-linearity error, and hysteresis error. 

(10 marks)

6. (a) Draw the block diagram of the elements in a general measurement system. Explain the function of each element and give one example of each. 

(8 marks)

(b) Describe the construction and operation of a strain gauge sensing element. 

(12 marks)

7. Describe, with the aid of diagrams, a laboratory experiment that you have performed on the calibration of either a thermocouple thermometer or a variable-area flowmeter. 

8. (a) Describe how the Out-Of-Balance Wheatstone bridge may be used as a signal converter. 

(8 marks)

(b) Describe the construction and operation of the following Elastic type sensor elements: diaphragm, capsule, and bellows. 

(12 marks)