Unit 64: Electrical and Electronic Measurement and Testing

Unit code: Y/601/1406
QCF level: 4
Credit value: 15

- **Aim**

This unit will develop the knowledge and skills required to perform complex measurement and test procedures on electrical and electronic systems.

- **Unit abstract**

Throughout their working lives, technicians and engineers in the electrical and electronic field of engineering make use of a comprehensive range of test and measurement instruments in order to perform their duties. This unit will develop the underpinning knowledge and skills required to perform complex measurement and test procedures in a wide range of engineering sectors.

Test and measurement procedures require the learner to consistently and accurately perform the task, at reasonable costs, to be able to convert results to suitable formats or conduct monitoring performance purposes. The development of such skills in using test equipment will further lead to abilities in troubleshooting electronic equipment or verifying theoretical concepts.

This unit takes the learner through a logical process of development by firstly considering the concepts of a measurement system and the associated terminology. Learners will adopt a hands-on approach by using different methods (for example spreadsheets) to solve problems relating to data that has been measured. Learners are then introduced to a variety of test equipment and shown the correct choice and use for a particular application. Finally, learner will examine the principles and techniques used in data acquisition.

- **Learning outcomes**

On successful completion of this unit a learner will:

1. Be able to analyse a measurement system and solve problems relating to the characteristics of a signal
2. Be able to analyse the principles and techniques employed in measurement
3. Be able to select and use test equipment to measure a range of signals
4. Be able to apply the principles and techniques used in data acquisition systems.
Unit content

1. **Be able to analyse a measurement system and solve problems relating to the characteristics of a signal**

   *Measurement systems and terms*: system eg transducers; transmission systems; instruments; terms eg response of the systems, transfer function, impulse response, frequency response, dynamic range; block diagram of typical measurement/transmission systems

   *Transmission systems*: coaxial; twisted pair; flat cable; fibre-optic; attenuation, phase change and frequency response; noise and noise reduction; comparison of different types of transmission systems

   *Characteristics of signals*: continuous signals; discrete signals; frequency and period; peak; average; effective value; phase shift; amplitude; peak to peak; time domain; frequency domain; Fourier series of signals

2. **Be able to analyse the principles and techniques employed in measurement**

   *Characteristics of data*: error/accuracy/precision; significant digits; rounding numbers; types of errors; statistics; solution of problems relating to data that has been measured

   *Graphical techniques*: linear graphs; polar graphs; logarithmic graphs; solution of problems using graphical analytical techniques eg interpretation of graphs; finding the best-fit straight line; use of spreadsheets

3. **Be able to select and use test equipment to measure a range of signals**

   *Selection and use of test equipment*: specify the correct equipment to measure a signal; practical use and description of test equipment

   *Test equipment*: specifications of equipment; operation of equipment eg oscilloscopes, meters, signal generators, counters, logic analysers, spectrum analysers; block diagrams to explain the operation of selected test equipment

4. **Be able to apply the principles and techniques used in data acquisition systems**

   *Acquisition systems*: comparison of types of system interfaces (analogue to analogue, analogue to digital, digital to digital); identification of system elements eg data acquisition, data analysis and data presentation; identification of hardware and software required to capture data from an item under test

   *Application*: overview of data acquisition systems eg block diagram of typical system and explanation of its operation; input section eg transducers, signal conditioning and multiplexer; sampling methods; output filtering and corrections (sin x/x); errors; A/D conversion; CPU and I/O devices; comparison of data recording methods eg graphic, magnetic; operation of bus structures; block diagrams of typical structures and comparison of types of bus structures in use; control of data lines; application of a data acquisition system to determine the performance of an item under test; analysis of results from a system
# Learning outcomes and assessment criteria

<table>
<thead>
<tr>
<th>Learning outcomes</th>
<th>Assessment criteria for pass</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>On successful completion of this unit a learner will:</strong></td>
<td><strong>The learner can:</strong></td>
</tr>
<tr>
<td>LO1 Be able to analyse a measurement system and solve problems relating to the characteristics of a signal</td>
<td>1.1 analyse a measurement system</td>
</tr>
<tr>
<td></td>
<td>1.2 solve problems relating to the characteristics of signals</td>
</tr>
<tr>
<td></td>
<td>1.3 compare different types of transmission systems</td>
</tr>
<tr>
<td>LO2 Be able to analyse the principles and techniques employed in measurement</td>
<td>2.1 solve problems relating to data that has been measured</td>
</tr>
<tr>
<td></td>
<td>2.2 solve problems using graphical techniques</td>
</tr>
<tr>
<td></td>
<td>2.3 solve problems using spreadsheets</td>
</tr>
<tr>
<td>LO3 Be able to select and use test equipment to measure a range of signals</td>
<td>3.1 describe the operation of items of test equipment</td>
</tr>
<tr>
<td></td>
<td>3.2 select and use items of test equipment to measure signals</td>
</tr>
<tr>
<td>LO4 Be able to apply the principles and techniques used in data acquisition systems</td>
<td>4.1 identify the hardware and software required to capture data from an item under test</td>
</tr>
<tr>
<td></td>
<td>4.2 investigate the operation of a data acquisition system</td>
</tr>
<tr>
<td></td>
<td>4.3 apply a data acquisition system to determine the performance of an item under test</td>
</tr>
<tr>
<td></td>
<td>4.4 analyse the results obtained from the data acquisition.</td>
</tr>
</tbody>
</table>
Guidance

Links
This unit can be linked to Unit 5: Electrical and Electronic Principles.

Essential requirements
A range of laboratory test equipment (for example L-C-R boxes, waveform generators, oscilloscopes, waveform analysers, and test meters, etc) will need to be available, along with appropriate data acquisition, recording and analytical software packages.

Employer engagement and vocational contexts
Delivery of this unit will benefit from centres establishing strong links with employers willing to contribute to the delivery of teaching, work-based placements and/or detailed case study materials.