

**1. Module details****Module name****Electronic Instrumentation****Module duration**

It is expected that students with the appropriate entry knowledge and skills will successfully complete this module in 36 - 40 hours.

**Module code**

NUE155

**Discipline code**

0703115 Electrical Measurement and Measuring Instruments.

**2. Module purpose**

This module will provide students with the knowledge to correctly select test equipment for a particular measurement requirement and to correctly operate the test equipment to obtain valid measurement results.

**3. Prerequisites**

EB162 Circuit Analysis 1.

**4. Relationship to competency standards**

This module provides part of the underpinning knowledge and skills in the 'Evidence Guide' of specific units of competency in the National Electrotechnology Training Package and provides similar support, where mapped, to equivalent units in the National Metals and Engineering Competency Standards. For details refer to the module to unit maps, available from NUEITAB.

**5. Content****Loading and matching****Connectors****Decibels: dBm, dBr, dBu, dBo****Storage and delay****Frequency counters****Frequency synthesisers****Spectrum analysers****Noise and distortion meters****RF communications service monitor**

## 6. Assessment strategy

### Assessment methods

Assessment should be progressive reflecting a holistic approach to ensure the module purpose is met. To assist in ensuring validity, reliability and fairness assessment instruments should include practical exercises, assignments and written tests consisting of a number of item types, such as multiple choice, short answer and problem solving.

### Conditions of assessment

Learning and assessment will take place in an environment that is conducive to a learner's development.

## 7. Learning outcome details

### Learning outcome 1

**Describe the effects of test equipment loading and the need to match load to source in particular measurement scenarios.**

### Assessment criteria

- 1.1 Describe load impedance and source impedance.
- 1.2 Describe the effects of impedance mismatches on low-frequency measurement accuracy.
- 1.3 Describe the effects of impedance mismatches on radio frequency measurement accuracy.
- 1.4 Observe the effects of source/line/load mismatches on the load power and on the line characteristics given suitable signal source, VSWR measuring equipment, connecting cables, load resistors, and power meters.
- 1.5 State typical load impedances and power ratings for various electrical and electronic equipment.

### Learning outcome 2

**Identify typical electrical/electronic connectors and state typical capacities, uses, fit-off and cautions.**

### Assessment criteria

- 2.1 Recognise typical connectors for the 240 V AC mains.
- 2.2 Recognise typical audio connectors.
- 2.3 Recognise typical RF connectors.
- 2.4 Recognise typical computer connectors.
- 2.5 Recognise industry-specific and/or sector-specific connectors.

**Learning outcome 3**

**Assessment criteria**

- 2.6 Describe the connector electrical characteristics, typical use(s), correct termination and fit-off, and relevant cautions given sample connectors relevant to an industry or industry sector.
  - 2.7 Observe all relevant cautions and demonstrate approved methods for connection and disconnection, including use of torque wrenches for specific applications such as SMA and VHDI connectors given sample connectors relevant to an Industry or Industry sector.
  - 2.8 Observe all relevant cautions and demonstrate correct termination and fit-off given sample connectors relevant to an industry or industry sector.
- State the appropriate use of the decibel units dBm, dBr, dBu, dBo, and perform calculations using the correct unit(s) in context.**
- 3.1 Convert numerical power, voltage and current ratios into decibels units.
  - 3.2 Convert numerical power, voltage and current levels into the appropriate decibel units.
  - 3.3 Convert both relative and absolute decibel levels into ratios or voltage/current/power levels as appropriate.
  - 3.4 Convert the maximum output power in terms of decibels into the actual maximum levels in terms of voltage, current or power levels as appropriate.
  - 3.5 Given minimum detectable signal levels in terms of voltage, current or power decibel terms, calculate the minimum detectable signal levels in volts and in decibels to deliver the rated power output (at the specified SINAD ratings if relevant) using the correct decibel terms.
  - 3.6 Verify equipment performance against listed specifications given receiving and/or amplifying equipment, suitable signal generators, loads and power meters.

**Learning outcome 4**

**Describe the necessity for storage and delay capabilities in test equipment and describe current storage and delay technologies.**

**Assessment criteria**

- 4.1 Describe the techniques and processes used in analog-to-digital conversion.
- 4.2 Describe decimation and sampling rates.
- 4.3 Describe quantisation errors.
- 4.4 Describe sampling rate errors.
- 4.5 Manually display waveforms to optimum resolution and compare manual settings to automatic settings given digital oscilloscopes.

**Learning outcome 5**

**Describe typical frequency counters in common use and their applications.**

**Assessment criteria**

- 5.1 List the range of frequencies typically measured in the relevant industry/industry sector.
- 5.2 Describe the need for accurate frequency measurement and state typical accuracies required.
- 5.3 List sources of standard frequencies and/or calibration frequencies where relevant.
- 5.4 Describe (at the block diagram level) frequency counters in use in the relevant industry/industry sector.
- 5.5 Comment on the suitability of digital voltmeter-hosted frequency measuring facilities for the relevant industry/industry sector.
- 5.6 Comment on the suitability of computer-hosted frequency measuring facilities for the relevant Industry/Industry sector.
- 5.7 Use various types of frequency counters to determine the actual frequencies under measurement and comment on the accuracy of measurements given signals of frequencies typically encountered in the relevant Industry/Industry sector.
- 5.8 State the precision of typical frequency counters and comment on their suitability for particular measurement tasks.

**Learning outcome 6**

**Describe typical frequency synthesisers in common use and their applications.**

**Assessment criteria**

- 6.1 List the range of test signal frequencies, signal levels and types of signals typically required in the relevant industry/industry sector.
- 6.2 Describe the need for accurate signal levels, frequencies and characteristics (such as modulation) and state typical accuracy's required.
- 6.3 List sources of standard frequencies and/or calibration frequencies where relevant.
- 6.4 Describe (at the block diagram level) frequency synthesisers in use in the relevant industry/industry sector.
- 6.5 Comment on the suitability of computer-hosted frequency synthesiser facilities for the relevant industry/industry sector.
- 6.6 Successfully complete typical frequency synthesiser setups required by the relevant industry/industry sector.
- 6.7 State the precision of typical frequency synthesisers and comment on their suitability for particular measurement tasks.

**Learning outcome 7**

**Describe typical spectrum analysers in common use and their applications.**

**Assessment criteria**

- 7.1 List the measuring tasks in the relevant industry/industry sector that may require spectrum analysis.
- 7.2 Describe the purpose of spectrum analysis and the uses to which such analysis is commonly put.
- 7.3 Describe, in terms of spectrum peaks and population, the typical signals subject to spectral analysis in the relevant industry/industry sector.
- 7.4 Describe (at the block diagram level) spectrum analysers in use in the relevant industry/industry sector.
- 7.5 Comment on the suitability of computer-hosted spectrum analysers for the relevant industry/industry sector.

**Learning outcome 8**

- 7.6 Use typical spectrum analyser(s) to perform measurements required by the relevant industry/industry sector.
- 7.7 Comment on the performance of the equipment analysed given typical spectrum analyser plots specifications for the equipment under test.

**Determine the appropriate measurement regime and measuring equipment required to measure the noise and distortion performance of systems and equipment.**

**Assessment criteria**

- 8.1 Describe the nature of electrical and electronic noise. (Distinguish between thermal noise and equipment-induced noise).
- 8.2 Calculate the thermal noise floor for a given bandwidth and source impedance.
- 8.3 Test and evaluate equipment based on its calculated noise performance and its specified noise performance.
- 8.4 Describe distortion in terms of harmonic distortion and intermodulation distortion.
- 8.5 Distinguish between test generator distortion and equipment-induced distortion.
- 8.6 Test and evaluate equipment based on its expected distortion performance and its specified distortion performance.

**Learning outcome 8**

**RF Communications Service Monitor.**

**Assessment criteria**

- 8.1 Describe the RF Communications Service Monitor in terms of:
  - Its responsibilities over radio communications
  - Public access to RF Communications Service Monitor standards
  - The Government Department administering the Monitor.

**8. Delivery of the module**

**Delivery strategy**

Delivery strategies must be suitable for learning both theoretical and practical aspects described in the module purpose. It is considered that the most effective method to achieve this is by integration of theory and practice where students learn by experimentation, research and reports. It is recommended that learning and assessment be facilitated in a holistic manner that may require learning outcome sequence other than that indicated in the module.

**Resource requirements**

*Resources should be sufficient for students to carry out learning activities on an individual basis. This will require the following:*

Suitable laboratory equipment: benches, lighting, adequate working space and ventilation, seating, hand soldering and IDC stations and equipment, heatshrink equipment, torque wrenches for specialised connectors.

Test equipment: cable and connector test equipment/sets, power supplies, connecting cables, multimeters, analog and digital signal generators, oscilloscopes, VSWR meters, RF loads, RF power meters, frequency counters, spectrum analysers.

Equipment under test: receivers, transmitters, instrumentation amplifiers, power amplifiers.

Consumables: connectors, cables, heatshrink tubing.

Equipment/service manuals or textbook descriptions of equipment, including alignment and faultfinding procedures.

**Occupational health and safety requirements**

A safe and healthy environment will be provided for students and teachers as well as the particular safety procedures followed as part of the learning / teaching activity and content.