# Course outline: 142 Magnetism G101A
# UEENEEG101A - Solve problems in electromagnetic devices and related circuits

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| **Qualification:** | Certificate III in Electrotechnology Electrician - UEE30811 |
| **Applicable to:** | Learners, industry/employers, governments, community and Global Energy Training Solutions as the provider |
| **Unit of competency:** | Accessible from: http://training.gov.au/Training/Details/UEENEEG101A |
| **Related policies:** | Policy & Procedure 1 – Enrolment Policy<br>Policy & Procedure 2 – Credit Transfer & Recognition of Prior Learning<br>Policy & Procedure 3 – Learner Support<br>Policy & Procedure 4 – Assessment<br>Policy & Procedure 5 – Academic Misconduct<br>Policy & Procedure 6 – Alcohol & Other Drugs<br>Policy & Procedure 7 – Access, Equity & Diversity<br>Policy & Procedure 8 – Vulnerable People<br>Policy & Procedure 9 – Work, Health & Safety<br>Policy & Procedure 10 – Incident, Injury & Rehabilitation<br>Policy & Procedure 11 – Competency, & Qualification Assessment Decisions<br>Policy & Procedure 12 – Complaints & Appeals<br>Policy & Procedure 13 – Privacy<br>Policy & Procedure 14 – Fees<br>Policy & Procedure 15 – Industry & Employer Engagement<br>Policy & Procedure 16 – Trainers & Assessors<br>Policy & Procedure 17 – Administration & Other Staff<br>Policy & Procedure 18 – Quality Assurance<br>Policy & Procedure 19 – Business & Financial Risk Management<br>Policy & Procedure 20 – Changes to Qualifications or Business<br>Policy & Procedure 21 – Conflict of Interest<br>Policy & Procedure 22 – Records Management<br>Policy & Procedure 23 – Marketing & Advertising |
| **Monitor and review:** | Policy & Procedure 18 – Quality Assurance |
| **Responsibility:** | Ben Murphy – as Proprietor |
| **Questions/queries:** | Feedback and suggestions welcomed: office@gets.com.au (+61) 02 6262 0077 |

## Table of Contents



## 1. Material requirements

- AS/NZS 3000:2007 incorporating amendment 1 and 2
- Scientific calculator, ruler, pens and pencils
- Note book
- Hand tools
- Covered footwear
- Internet access (provided)

## 2. Session summaries

| Day 1 | |
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| Required Skills and Knowledge | T1 Magnetism encompassing:<br>• magnetic field pattern of bar and horse-shoe magnets.<br>• magnets attraction and repulsion when brought in contact with each other.<br>• common magnetic and non-magnetic materials and groupings (diamagnetic, paramagnetic and ferromagnetic materials).<br>• principle of magnetic screening (shielding) and its applications.<br>• practical applications of magnets<br>• construction, operation and applications of reed switches.<br><br>T2 Electromagnetism encompassing:<br>• conventions representing direction of current flow in a conductor.<br>• magnetic field pattern around a single conductor and two adjacent conductors carrying current.<br>• Using the “right hand rule” to determine the direction of magnetic field around a current carrying conductor.<br>• direction of force between adjacent current carrying conductors.<br>• effect of current, length and distance apart on the force between conductors (including forces on bus bars during fault conditions).<br>• magnetic field around an electromagnet.<br>• Using the “right hand rule” to determine the direction of magnetic field around a current carrying coil.<br>• magnetomotive force (m.m.f.) and its relationship to the number of turns in a coil and the current flowing in the coil. |

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| | • practical applications of electromagnets. |

| Day 2 | |
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| Required Skills and Knowledge | T3 Magnetic circuits encompassing:<br>• magnetic characteristic curve for various materials and identify the various regions.<br>• Identify the various conditions of a magnetic material from its Hysteresis loop.<br>• factors which determine losses in magnetic material.<br>• methods used to reduce electrical losses in a magnetic circuit.<br>• magnetic flux (definition, unit and symbol).<br>• reluctance as the opposition to the establishment of magnetic flux.<br>• permeability (definition, symbol and unit).<br>• difference for magnetic and non-magnetic materials in regards to reluctance and permeability.<br>• calculation of m.m.f., flux or reluctance given any two values.<br>• flux density (definition, symbol, unit and calculation).<br>• magnetising force (definition, symbol, unit and calculation).<br>• common magnetic circuit types.<br>• effect of an air gap in a magnetic circuit.<br>• terms “magnetic leakage” and “magnetic fringing”.<br><br>T4 Electromagnetic induction encompassing:<br>• principle of electromagnetic induction (Faraday’s law of electromagnetic induction).<br>• applying “Fleming’s right hand rule” to a current a carrying conductor under the influence of a magnetic field.<br>• calculation of induced e.m.f. in a conductor given the conductor length, flux density and velocity of the conductor.<br>• calculation of induced e.m.f. in a coil given the number of turns in a coil and the rate of change of flux.<br>• calculation of force on a conductor given the flux density of the magnetic field, length of the conductor and the current being carried by the conductor.<br>• Lenz’s law<br>• applications of electromagnetic induction |

| Day 3 | |
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| Required Skills and Knowledge | T5 Inductance encompassing:<br>• construction of an inductor, including a bifilar winding inductor.<br>• Australian Standard circuit diagram symbol for the four types of inductor.<br>• effect of physical parameters on the inductance of an inductor.<br>• common types of inductor cores.<br>• applications of the different types of inductors.<br>• definition of terms self induction, inductance and mutual inductance.<br>• calculation of value of self induced e.m.f. in a coil.<br>• mutual induction occurs between two coils.<br>• graphical relationship between load voltage, current and self induced e.m.f. in a single d.c. circuit having inductance.<br>• practical applications for the effects of self and mutual induction.<br>• undesirable effects of self and mutual induction.<br>• definition of term “time constant” and draw the characteristic curve as applied to a series circuit containing an inductor and a resistor. (LR circuit)Calculation of value of the time constant for an LR circuit given the values of the components.<br>• time constants required for the current in an LR circuit to reach its final value.<br>• determining of instantaneous values of voltage and current in an LR circuit using a universal time constant chart. |

| Day 4 | |
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| Required Skills and Knowledge | T6 Measurement Instruments encompassing:<br>• moving coil, moving iron, dynamometer meter movements and clamp testers.<br>• practical applications for moving coil, moving iron and dynamometer meter movements.<br>• Calculation of resistance of shunts and multipliers to extend the range of ammeters and voltmeters.<br>• factors to be considered in selecting meters for a particular application.<br>• safety category of meters and their associated applications.<br>• steps and procedures for the safe use, care and storage of electrical instruments.<br><br>T7 Magnetic devices encompassing:<br>• construction, operation and applications of relays.<br>• construction, operation and applications of contactors.<br>• magnetic methods used to extinguish the arc between opening contacts.<br>• construction, operation and applications of Hall Effect devices.<br>• operation and applications of magnetostriction equipment.<br>• construction, operation and application of magnetic sensing devices. |

| Day 5 | |
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| Required Skills and Knowledge | T8 Machine principles encompassing:<br>• basic operating principle of a generator.<br>• applying Fleming's right hand rule for generators.<br>• basic operating principle of a motor.<br>• applying Fleming's left hand rule for motors.<br>• calculation of force and torque developed by a motor.<br><br>T9 Rotating machine construction, testing and maintenance encompassing:<br>• components of a d.c. machine.<br>• difference between a generator and a motor in terms of energy conversion.<br>• nameplate of a machine.<br>• using electrical equipment to make electrical measurements and comparison of readings with nameplate ratings.<br>• Identification of faults in a machine from electrical measurements.<br>• care and maintenance processes for rotating machines<br>• safety risks associated with using rotating machinery. |

| Day 6 | |
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| Required Skills and Knowledge | T10 Generators encompassing:<br>• basic operation of a d.c generator.<br>• calculation of generated and terminal voltage of a d.c. shunt generator<br>• prime movers, energy sources and energy flow used to generate electricity.<br>• types of d.c. generators and their applications.<br>• methods of excitation used for d.c generators.<br>• equivalent circuit for a d.c. generator.<br>• importance of residual magnetism for a self excited generator.<br>• open circuit characteristics of d.c. generators.<br>• load characteristics of a d.c generator.<br>• reversing the polarity of a d.c. generator<br>• Connect and test a d.c generator on no-load and load<br>• Identify safety risks associated with using generators.<br><br>T11 Motors encompassing: |

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| | • operation of a motor and its energy flow.<br>• effect of back e.m.f. in d.c. motors<br>• torque as the product of the force on the conductors and the radius of the armature/rotor.<br>• types of d.c. motors and their applications.<br>• circuit diagrams for the types of d.c. motors.<br>• equivalent circuit for the types of d.c. motors.<br>• calculation of power output of a motor.<br>• characteristics of the different types of d.c. motors.<br>• connection and testing a d.c. shunt motor on no-load and load<br>• reversing the direction of rotation of a d.c. motor.<br>• safety risks associated with using motors (include risks of series d.c. motors). |

| **Day 7** | | |
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| Required Skills and Knowledge | T12 | Machine efficiency encompassing:<br>• losses that occur in a d.c machine.<br>• methods used to determine the losses in a d.c. machine.<br>• calculation of losses and efficiency of a d.c machine.<br>• efficiency characteristic of a d.c. machine and the conditions for maximum efficiency.<br>• application of Minimum Energy Performance standards (MEPS).<br>• methods used to maintain high efficiency. |

## 3. Elements and Performance Criteria

Elements and Performance Criteria require practice and demonstration in the work place.

| **Element** | | **Performance Criteria** | **Work Performance** |
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| 1: Prepare to work on electro-magnetic devices and circuits. | 1.1 | OHS procedures for a given work area are identified, obtained and understood. | ☐ Satisfactory<br>☐ Needs improvement<br>☐ Not performed |
| | 1.2 | OHS risk control work preparation measures and procedures are followed. | ☐ Satisfactory<br>☐ Needs improvement<br>☐ Not performed |
| | 1.3 | The nature of the device(s)/circuit(s) problem is obtained from documentation or from work supervisor to establish the scope of work to be undertaken. | ☐ Satisfactory<br>☐ Needs improvement<br>☐ Not performed |
| | 1.4 | Advice is sought from the work supervisor to ensure the work is coordinated effectively with others. | ☐ Satisfactory<br>☐ Needs improvement<br>☐ Not performed |
| | 1.5 | Sources of materials that may be required for the work are established in accordance with established procedures. | ☐ Satisfactory<br>☐ Needs improvement<br>☐ Not performed |
| | 1.6 | Tools, equipment and testing devices needed to carry out the work are obtained and checked for correct operation and safety. | ☐ Satisfactory<br>☐ Needs improvement<br>☐ Not performed |
| 2:Solve electro-magnetic devices/ circuit problems. | 2.1 | OHS risk control measures and procedures for carrying out the work are followed. | ☐ Satisfactory<br>☐ Needs improvement<br>☐ Not performed |
| | 2.2 | The need to test or measure live is determined in strict accordance with OHS requirements and when necessary conducted within established safety procedures. | ☐ Satisfactory<br>☐ Needs improvement<br>☐ Not performed |

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| | 2.3 | Circuits/machines/plant are checked as being isolated where necessary in strict accordance OHS requirements and procedures. | ☐ Satisfactory<br>☐ Needs improvement<br>☐ Not performed |
| | 2.4 | Established methods are used to solve circuit problems from measure and calculated values as they apply to single and three-phase low voltage circuit. | ☐ Satisfactory<br>☐ Needs improvement<br>☐ Not performed |
| | 2.5 | Unexpected situations are dealt with safely and with the approval of an authorised person. | ☐ Satisfactory<br>☐ Needs improvement<br>☐ Not performed |
| | 2.6 | Problems are solved without damage to apparatus, circuits, the surrounding environment or services and using sustainable energy practices. | ☐ Satisfactory<br>☐ Needs improvement<br>☐ Not performed |
| 3:Complete work and document problem solving activities. | 3.1 | OHS work completion risk control measures and procedures are followed. | ☐ Satisfactory<br>☐ Needs improvement<br>☐ Not performed |
| | 3.2 | Work site is cleaned and made safe in accordance with established procedures. | ☐ Satisfactory<br>☐ Needs improvement<br>☐ Not performed |
| | 3.3 | Justification for solutions used to solve circuit problems is documented. | ☐ Satisfactory<br>☐ Needs improvement<br>☐ Not performed |
| | 3.4 | Work completion is documented and an appropriate person or persons notified in accordance with established procedures. | ☐ Satisfactory<br>☐ Needs improvement<br>☐ Not performed |

## 4. Assessments

| Assessment | When | Satisfactory mark/outcome |
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| Theory assessment 1 | Day 3 | 70% |
| Theory assessment 2 | Day 5 | 70% |
| Theory assessment 3 | Day 7 | 70% |
| Practical assessment 1 | Day 4 | 100% |
| Practical assessment 2 | Day 6 | 100% |
| Workplace Observation | After theory and practical assessments | Must be valid, sufficient, authentic and current |
| Employer Competency report | | |
| Structured workplace experience interview | | |
| Note: Once all theory, practical and on-site assessments are complete, competency assessment decisions can be made in conjunction with the learner, employer and registered training organisation. | | |

## 5. Version control

| Version | Date of release | Author | Authorised by | Position | Rational for change |
|---|---|---|---|---|---|
| V1 | 5/10/2015 | Ben Murphy | Ben Murphy | Proprietor | Initial release |
| V2 | 7/2/2017 | Ben Murphy | Ben Murphy | Proprietor | Added Elements and Performance Criteria |