REQUIRED SKILLS AND KNOWLEDGE – UEENEEG101A		
KS01-EG101A Electromagnetic devices and circuits		
Topic and Description	**NIDA Lesson**	**CARD #**
T1 Magnetism encompassing: • magnetic field pattern of bar and horse-shoe magnets. • magnets attraction and repulsion when brought in contact with each other. • common magnetic and non-magnetic materials and groupings (diamagnetic, paramagnetic and ferromagnetic materials). • principle of magnetic screening (shielding) and its applications. • practical applications of magnets • construction, operation and applications of reed switches.	5142-310-130 Magnetism and Electromagnetic Principles ▪ Define magnetism. ▪ Describe different types of magnetism. ▪ Describe relays, motors, transformers, and generators. ▪ Observe magnetic poles. ▪ Demonstrate temporary magnets. ▪ Examine electromagnetic operation. ▪ Demonstrate an application of magnetism.	182, 183
T2 Electromagnetism encompassing: • conventions representing direction of current flow in a conductor. • magnetic field pattern around a single conductor and two adjacent conductors carrying current. • Using the "right hand rule" to determine the direction of magnetic field around a current carrying conductor. • direction of force between adjacent current carrying conductors. • effect of current, length and distance apart on the force between conductors (including forces on bus bars during fault conditions). • magnetic field around an electromagnet.		

• Using the "right hand rule" to determine the direction of magnetic field around a current carrying coil. • magnetomotive force (m.m.f.) and its relationship to the number of turns in a coil and the current flowing in the coil. • practical applications of electromagnets.		
T3 Magnetic circuits encompassing: • magnetic characteristic curve for various materials and identify the various regions. • Identify the various conditions of a magnetic material from its Hysteresis loop. • factors which determine losses in magnetic material. • methods used to reduce electrical losses in a magnetic circuit. • magnetic flux (definition, unit and symbol). • reluctance as the opposition to the establishment of magnetic flux. • permeability (definition, symbol and unit). • difference for magnetic and non-magnetic materials in regards to reluctance and permeability. • calculation of m.m.f., flux or reluctance given any two values. • flux density (definition, symbol, unit and calculation). • magnetising force (definition, symbol, unit and calculation). • common magnetic circuit types. • effect of an air gap in a magnetic circuit. • terms "magnetic leakage" and "magnetic fringing".	5142-310-160 Magnetic Calculations . ▪ Describe properties of magnetic lines of force. ▪ Identify magnetic and non-magnetic materials. ▪ Identify the characteristics of electromagnetism. ▪ Calculate magnetomotive force. ▪ Calculate magnetic field strength. ▪ Determine force. ▪ Determine torque.	

T4 Electromagnetic induction encompassing: • principle of electromagnetic induction (Faraday's law of electromagnetic induction). • applying "Fleming's right hand rule" to a current a carrying conductor under the influence of a magnetic field. • calculation of induced e.m.f. in a conductor given the conductor length, flux density and velocity of the conductor. • calculation of induced e.m.f. in a coil given the number of turns in a coil and the rate of change of flux. • 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. • Lenz's law • applications of electromagnetic induction •	.	
T5 Inductance encompassing: • construction of an inductor, including a bifilar winding inductor. • Australian Standard circuit diagram symbol for the four types of inductor. • effect of physical parameters on the inductance of an inductor. • common types of inductor cores. • applications of the different types of inductors. • definition of terms self induction, inductance and mutual inductance. • calculation of value of self induced e.m.f. in a coil. • mutual induction occurs between two coils. • graphical relationship between load voltage, current and self induced e.m.f. in a single d.c. circuit having inductance. • practical applications for the effects of self and mutual induction. • undesirable effects of self and mutual induction.		

• 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. • time constants required for the current in an LR circuit to reach its final value. • determining of instantaneous values of voltage and current in an LR circuit using a universal time constant chart. •		
T6 Measurement Instruments encompassing: • moving coil, moving iron, dynamometer meter movements and clamp testers. • practical applications for moving coil, moving iron and dynamometer meter movements. • Calculation of resistance of shunts and multipliers to extend the range of ammeters and voltmeters. • factors to be considered in selecting meters for a particular application. • safety category of meters and their associated applications. • steps and procedures for the safe use, care and storage of electrical instruments.	5021-114-130 Magnetism, Relays, and Meters ▪ Define magnetism. ▪ Identify characteristics of magnets. ▪ Define laws of magnetic attraction and repulsion. ▪ Describe properties of magnetic lines of force. ▪ Identify non-magnetic materials. ▪ Define electromagnetism. ▪ Identify the characteristics of electromagnetism. ▪ Describe the operation of a relay. ▪ Describe the operation of a magnetic circuit breaker. ▪ Describe the operation of a meter.	
T7 Magnetic devices encompassing: • construction, operation and applications of relays. • construction, operation and applications of contactors. • magnetic methods used to extinguish the arc between opening contacts. • construction, operation and applications of Hall Effect devices. • operation and applications of magnetostriction equipment. • construction, operation and application of magnetic sensing	5021-114-130 Magnetism, Relays, and Meters ▪ Define magnetism. ▪ Identify characteristics of magnets. ▪ Define laws of magnetic attraction and repulsion. ▪ Describe properties of magnetic lines of force. ▪ Identify non-magnetic materials. ▪ Define electromagnetism. ▪ Identify the characteristics of electromagnetism. ▪ Describe the operation of a relay. ▪ Describe the operation of a magnetic circuit breaker. ▪ Describe the operation of a meter.	

devices.	5021-326-130 Relays . ▪ Describe the purpose and types of relays. ▪ Describe basic relay construction and operation. ▪ Identify the schematic symbol and reference designator for relays. ▪ Describe the latched and time delay relay. ▪ Describe a solenoid.	
T8 Machine principles encompassing: • basic operating principle of a generator. • applying Fleming's right hand rule for generators. • basic operating principle of a motor. • applying Fleming's left hand rule for motors. • calculation of force and torque developed by a motor.	5142-312-130 Introduction to Rotating Machinery ▪ Describe the various devices that are called rotating machinery. ▪ Describe Speed, Torque, Counter Electromotive Force (CEMF), Loads, Power, and Efficiency in rotating machinery.	
T9 Rotating machine construction, testing and maintenance encompassing: • components of a d.c. machine. • difference between a generator and a motor in terms of energy conversion. • nameplate of a machine. • using electrical equipment to make electrical measurements and comparison of readings with nameplate ratings. • Identification of faults in a machine from electrical measurements. • care and maintenance processes for rotating machines • safety risks associated with using rotating machinery.		
T10 Generators encompassing: • basic operation of a d.c generator.	5142-312-160 DC Motors and Generators . ▪ Describe the operation of DC motors. ▪ Describe the operation of DC generators.	180

• calculation of generated and terminal voltage of a d.c. shunt generator • prime movers, energy sources and energy flow used to generate electricity. • types of d.c. generators and their applications. • methods of excitation used for d.c generators. • equivalent circuit for a d.c. generator. • importance of residual magnetism for a self excited generator. • open circuit characteristics of d.c. generators. • load characteristics of a d.c generator. • reversing the polarity of a d.c. generator • Connect and test a d.c generator on no-load and load • Identify safety risks associated with using generators.	▪ Observe the normal operation of a DC motor-generator set. ▪ Measure signals in the control circuits for a DC motor-generator set. ▪ Troubleshoot a DC motor-generator set.	
T11 Motors encompassing: • operation of a motor and its energy flow. • effect of back e.m.f. in d.c. motors • torque as the product of the force on the conductors and the radius of the armature/rotor. • types of d.c. motors and their applications. • circuit diagrams for the types of d.c. motors. • equivalent circuit for the types of d.c. motors. • calculation of power output of a motor. • characteristics of the different types of d.c. motors. • connection and testing a d.c. shunt motor on no-load and load • reversing the direction of rotation of a d.c. motor. • safety risks associated with using motors (include risks of series d.c. motors).	5142-312-160 DC Motors and Generators ▪ Describe the operation of DC motors. ▪ Describe the operation of DC generators. ▪ Observe the normal operation of a DC motor-generator set. ▪ Measure signals in the control circuits for a DC motor-generator set. ▪ Troubleshoot a DC motor-generator set. 5142-314-130 DC Series Field Motors ▪ Identify the principles and types of rotating machinery (motors). ▪ Describe basic DC motor action. ▪ Describe the DC series field motor. ▪ Identify the principles of circular force and torque. ▪ Describe the characteristics of a DC series field motor. ▪ Identify the loaded characteristics of a DC series field motor. 5142-314-160 Brushless DC Motors ▪ Identify the physical characteristics of BLDC motors. ▪ Describe the advantages of BLDC over other types. ▪ Understand basic BLDC types, applications, and configurations. ▪ Describe motor drive, position sensing, and other controller functions.	180

T12 Machine efficiency encompassing: • losses that occur in a d.c machine. • methods used to determine the losses in a d.c. machine. • calculation of losses and efficiency of a d.c machine. • efficiency characteristic of a d.c. machine and the conditions for maximum efficiency. • application of Minimum Energy Performance standards (MEPS). methods used to maintain high efficiency.		