

COURSE ELT3040: GENERATION/TRANSFORMATION**Level:** Advanced**Theme:** Power Systems**Prerequisite:** ELT1030 Conversion & Distribution**Description:** Students operate, experiment with and analyze alternators and transformers used in power generation and distribution.**Parameters:** AC/DC motor generator set, transformer kit, AC/DC volt ammeters, multimeter and related resources.**Note:** The student must have access to instruction from an individual with Electrical Technologist or journeyman status when students are operating low voltage alternators.**Curriculum and Assessment Standards**

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
<p><i>The student will:</i></p> <ul style="list-style-type: none"> • explain the principles of operation of electrical components used in safety devices 	<p><i>Assessment of student achievement should be based on:</i></p> <ul style="list-style-type: none"> • identifying and explaining the principles of operation of the following electrical safety protection devices: <ul style="list-style-type: none"> – plug and cartridge fuse – renewable and time-delay fuse – bi-metal and time-delay circuit breaker – overload protection by means of fuses and magnetic or thermal overload relays – ground-fault interrupter circuit protectors – safety switches. <p><i>Assessment Tool</i> <i>ELT3040–1: Presentations/Reports: Power Generation and Transformation</i></p> <p><i>Standard</i> <i>Performance rating of 3 for each applicable task</i></p>	<p>10</p>

COURSE ELT3040: GENERATION/TRANSFORMATION (continued)

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
<p><i>The student will:</i></p> <ul style="list-style-type: none"> • set up and operate three-phase low voltage alternators in no load and load conditions 	<p><i>Assessment of student achievement should be based on:</i></p> <ul style="list-style-type: none"> • setting up and operating a three-phase alternator under load and no load conditions • demonstrating resistive, inductive and capacitive load conditions • collecting data to plot the load graph. <p><i>Assessment Tool</i> <i>ELTLAB-1: Laboratory Practice, Part 2</i></p> <p><i>Standard</i> <i>Performance rating of 3 for each applicable task</i></p>	25
<ul style="list-style-type: none"> • explain the operational and loading parameters for alternators 	<ul style="list-style-type: none"> • explaining the following alternator parameters: <ul style="list-style-type: none"> – voltage generation – alternator regulation – voltage regulators – paralleling alternators – hunting – losses and efficiency – ratings – power factor – load characteristics graphs. <p><i>Assessment Tool</i> <i>ELT3040-1: Presentations/Reports: Power Generation and Transformation</i></p> <p><i>Standard</i> <i>Performance rating of 3 for each applicable task</i></p>	10
<ul style="list-style-type: none"> • operate a low voltage alternator in parallel with another alternator(s) 	<ul style="list-style-type: none"> • setting up and operating a three-phase low voltage alternator in parallel with another power source. <p><i>Assessment Tool</i> <i>ELTLAB-1: Laboratory Practice, Part 2</i></p> <p><i>Standard</i> <i>Performance rating of 3 for each applicable task</i></p>	15

COURSE ELT3040: GENERATION/TRANSFORMATION (continued)

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
<p><i>The student will:</i></p> <ul style="list-style-type: none"> • describe the operating principles of single-phase transformers • identify fundamental loading characteristics of single-phase transformers • demonstrate established laboratory procedures and safe work practices 	<p><i>Assessment of student achievement should be based on:</i></p> <ul style="list-style-type: none"> • setting up and operating a single-phase transformer in these conditions: <ul style="list-style-type: none"> – transformation characteristics – transformer polarity – transformer regulation – autotransformer characteristics – distribution transformers – transformers in parallel. <p><i>Assessment Tool</i> <i>ELT3040–1: Presentations/Reports: Power Generation and Transformation</i></p> <p><i>Standard</i> <i>Performance rating of 3 for each applicable task</i></p>	<p>25</p>
	<ul style="list-style-type: none"> • explaining the following single-phase transformer fundamentals: <ul style="list-style-type: none"> – theory of operation; no load – theory of operation; under load – transformer ratings – transformer ratios – losses and efficiency – autotransformer. <p><i>Assessment Tool</i> <i>ELT3040–1: Presentations/Reports: Power Generation and Transformation</i></p> <p><i>Standard</i> <i>Performance rating of 3 for each applicable task</i></p>	<p>10</p>
	<ul style="list-style-type: none"> • observed performance in following: <ul style="list-style-type: none"> – established laboratory procedures – correct procedures for high voltage applications – correct use of isolation transformers – correct use of overcurrent and overload protection. <p><i>Assessment Tool</i> <i>ELTPSP: Assessment Checklist: Laboratory Procedures and Safety Practices</i></p> <p><i>Standard</i> <i>Performance rating of 3 for each applicable task</i></p>	<p>5</p>

COURSE ELT3040: GENERATION/TRANSFORMATION (continued)

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
<p><i>The student will:</i></p> <ul style="list-style-type: none"> demonstrate basic competencies. 	<p><i>Assessment of student achievement should be based on:</i></p> <ul style="list-style-type: none"> observations of individual effort and interpersonal interaction during the learning process. <p><i>Assessment Tool</i> <i>Basic Competencies Reference Guide and any assessment tools noted above</i></p>	<p>Integrated throughout</p>

Concept	Specific Outcomes	Notes
Safety/Resource Management	<p><i>The student should:</i></p> <ul style="list-style-type: none"> demonstrate safe practices especially regarding high voltage system application, use of isolation transformers differentiate between overload and overcurrent protection use various electrical tests to insure safety of equipment/projects describe dangers relating to rotating shafts. 	<p>Observe hazards associated with backfeed on transformers.</p> <ul style="list-style-type: none"> Sloblow fuse HRC fuse circuit breaker other overload devices. <p>Live voltage projects must be activated through GFI circuit breaker.</p> <p>When instructional qualifications restrict high voltage use, projects may be done in low voltages (less than 30 volts).</p>
Testing	<ul style="list-style-type: none"> demonstrate a knowledge of alternator function by operating a three-phase alternator for various voltages, frequencies and phase sequences. 	<p>Small motor-generator sets are available on 1/3 horsepower machines. Surplus automotive alternator could be used.</p>
Designing and Prototyping	<ul style="list-style-type: none"> build a working model of a three-phase alternator. 	<p>Stationary coil moving magnet or vice versa.</p>

COURSE ELT3040: GENERATION/TRANSFORMATION (continued)

Concept	Specific Outcomes	Notes
Real-world Applications	<p><i>The student should:</i></p> <ul style="list-style-type: none"> • set up and operate or report on the operation of alternators in parallel • compare alternators and generators • inspect transformer installations used to produce correct voltage for consumer's equipment. 	<p>Alternators are brought "on-line" as necessary to supply loads in commercial power grids. Students could operate two or more alternators to supply a load in the laboratory.</p> <p>Electronic power supplies, school power service, field trip to substation, etc.</p>
Designing and Prototyping	<ul style="list-style-type: none"> • construct, operate and analyze step-up, step-down, 1:1, isolation and variable transformers such as: <ul style="list-style-type: none"> – Jacob's ladder – Tesla coil – mutual induction coil. 	<p><i>Radio Electronics Magazine.</i></p>
Applied Mathematics/Fundamentals	<ul style="list-style-type: none"> • explain principles of transformer action such as: <ul style="list-style-type: none"> – apparent power – voltage ratio – turns ratio – power transfer – voltage, amperage rating • explain schematic symbols and nameplate ratings. 	<p>A report could be prepared on the specific transformer built.</p>
Careers	<ul style="list-style-type: none"> • research employment opportunities in power generation and transformation. 	

