

General Curriculum Adopted by ECCC					page # on
	COURSE #	COURSE TITLE	LEC	LAB	outline
I. SAFETY					
I-A. General jobsite safety awareness					
1) Why safety is important					
2) Key factors involved with safe work practices					
3) Develop a respect for electricity					
a) be aware of dangers of shock					
b) describe locations of potential shock hazards					
c) demonstrate use of no contact voltage indicators and other devices to determine if the system is energized					
d) demonstrate techniques for working on energized circuits					
4) Hazards created by poor housekeeping on the job					
5) Maintain safe work area and tools					
6) Be aware of the dangers of falling objects					
7) Respect and obey job safety rules					
I-B. Emergency procedures					
1) First aid training and CPR					
I-C. Compliance with OSHA and EPA regulations					
1) Attend and/or conduct regular safety meeting					
2) General OSHA requirements on the jobsite					
3) The guidelines for OSHA Assured Grounding and GFI usage					
4) Use of material safety data sheets (MSDS) to identify and properly handle hazardous materials(e.g. cleaning fluids, transformer oils					
I-D. Substance abuse					

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II. TOOLS, MATERIALS AND HANDLING					
II-A. Proper tool management					
1) Identify common hand and power tools					
2) Proper selection and application of hand tools					
3) Proper selection and application of power tools					
4) Proper care for tools					
5) Safe techniques for using ladders					
6) Defects that make tools unsafe for use					
7) Use of meters to take readings					
II-B. Proper rigging methods					
1) Proper knots					
2) Proper techniques for rigging and hoisting					
3) Safe capacities for lifting arrangements					
II-C. Proper digging techniques					
1) Depth and shape of holes for supporting poles					
2) Proper techniques for digging, grading and leveling trenches for the installation of ducts					
II-D. Proper use of motorized tools (use of platform lifts, bucket trucks, and truck mounted cranes)					
II-E. Proper material management					
1) Identify commonly used materials by name					
2) Proper selection and application of materials					

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III. MATH					
III-A. Appropriate mathematical calculations to solve for unknowns					
1) Arithmetic operators					
2) Solving word problems					
3) Problems involving fractions					
4) Reducing fractions to lowest terms					
5) Converting decimals to fractions and back					
6) Angles and sides of triangles					
7) Unknown angles and sides of a triangle					
8) Metric prefixes and converting different prefixes					
9) Using powers of ten to perform math functions					
10) Converting from english to metric measuring systems					
11) Algebraic formulas					
12) Square roots					
13) Ratio, percentage, and proportion					
14) Problems using direct and inverse relationships					
IV. ELECTRICAL THEORY					
IV-A. Basic electrical theory					
1) Define terms, units of measure					
2) Electron flow					
3) Producing electrical current					
4) Products (effects of electrical current)					
IV-B. Ohm's Law, Kirchoff's Laws, Lenz's Law, Thevenin's and Norton's Theorems					

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IV. ELECTRICAL THEORY (cont.)					
IV-C. Series circuits					
1) Components					
2) Resistance of circuits					
3) Total resistance					
4) Effects of changing voltage and resistance					
5) Law of proportion for series voltage divider circuits					
6) Power used in circuits					
a) by components					
b) Wasted power					
IV-D. Parallel circuits					
1) Components					
2) Differences between series and parallel circuits					
3) Ohm's Law					
4) Circuits					
5) Total resistance using product-sum and reciprocal methods					
6) Alternate current paths					
7) Currents					
8) Law of proportion					
9) Power requirements of components					
IV-E. Combination circuits					
1) Combination circuits					
2) Components					
3) Equivalent resistance					
4) Alternate current paths					
5) Ohm's Law					
6) Power use and dissipation					

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IV. ELECTRICAL THEORY (cont.)					
IV-F. Characteristics of voltages in circuits					
1) Polarity and flow of electrons					
2) Distribution and voltage drops					
3) Proper wire size needed to lower losses					
IV-G. Characteristics of magnetism/electromagnetism					
IV-H. Theory of superposition and solving for multiple voltage sources circuits					
IV-I. Operation and characteristics of three wire systems					
IV-J. Operation and characteristics of three phase systems					
1) Identify differences between 3 wire single phase and three phase circuits					
2) Voltage drop and power loss					
IV-K. AC Theory					
1) Terms associated with ac theory					
2) Currents and voltages for components and circuits					
3) Conductor sizes using NEC					
4) Current and voltage sine waves to demonstrate phase relationships					
5) Maximum, effective (rms), average, and peak to peak voltage and current					
6) Inductance					
a) Factors that effect inductance					
b) Behavior of current when inductance is present					
c) Relationship between current, applied voltage. and counter-electromotive force					

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IV. ELECTRICAL THEORY (cont.)					
7) Capacitance					
a) Effects on circuits with capacitance					
b) Capacitance, capacitive reactance, and frequency					
8) Relationships and behaviors of series RL,					
parallel RL, series RC, parallel RC,					
series LC, parallel LC, series RLC, parallel					
RLC circuits					
9) Function, operation and characteristics					
of rectifiers					
a) Actions of full wave and half wave					
rectifiers					
b) Schematics					
10) Series resonance, parallel resonance and					
circuits					
11) Filters					
12) Power Factor					
a) Watts, vars, and volt-amperes					
b) Reactive power					
c) Proper placement of power factor					
correction capacitors					
d) Procedure to recognize and correct					
poor power factor arrangements					
13) Power quality issues					
a) Causes of poor power quality					
b) The effect of harmonics					
c) Locating harmonics through					
observation and test equipment					
d) Techniques to reduce and eliminate					
effects of harmonics					

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IV. ELECTRICAL THEORY (cont.)					
IV-L. Use of electronics					
1) Electron Flow through solid state components					
2) Precautions against electrostatic discharges around semi-conductor devices					
3) Functions, operation and characteristics of diodes and zener diodes					
a) characteristic curves					
b) testing procedures					
c) schematics including diodes					
4) Functions, operation and characteristics of transducers					
a) operation of transducers					
b) schematics including transducers					
5) Functions, operation and characteristics of various types of transistors (diacs, triacs, SCR's, etc.)					
a) operation of transistors					
b) current and voltage values					
c) testing procedures					
d) schematics including transistors					
6) Functions, operations, and characteristics and circuit configurations of amplifiers					
a) basic circuit configurations for various types of amplifiers					
7) Functions, operations and characteristics of integrated circuits (IC's)					
a) schematics of and including IC's					
b) information on data sheets for integrated circuits					
8) Functions, operations and characteristics of three main categories of photo-operated devices					

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V. CODE REQUIREMENTS (cont.)					
4) Utilizing code book					
a) mandatory rules					
b) fine print rules					
c) "neat and workmanlike"					
d) locate definitions					
e) interpretations					
f) recognize and use exceptions					
g) materials recognized by the NEC					
h) identify code markings					
i) distinguish wet, damp, and dry locations					
j) determine if specific installations are acceptable to the code					
k) requirements for special occupancies					
l) answer specific questions					
5) Use NEC to calculate various conductors and fill situations					
a) service conductors					
b) permissible loads on various circuits					
c) allowable cable tray fills					
d) imparity of various conductor and fill situations					
e) imparity of various circuits and load types					
f) overload protection for motors, equipment and phase converters					
g) minimum ampacity for motor disconnect means					
h) horsepower ratings for motors and disconnecting means					
i) grounding requirements					

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V. CODE REQUIREMENTS (cont.)					
6) Use NEC for hazardous locations					
a) hazardous locations by class					
b) equipment and wiring methods					
necessary for particular hazardous					
locations					
VI. CONDUCTORS					
VI-A. Various types of conductors					
1) Types of conductors and insulators					
2) Why some materials are better conductors					
or insulators than others					
3) Effect of heat on insulators					
4) Sizing and typing of conductors					
a) Use better symbols to identify insulator					
types					
b) Use American wire gauge chart					
c) Convert inches, mils, square mils, and					
circular mils from one to the other					
5) Differences between aluminum and copper					
conductors					
6) Properties of high voltage cables					
7) Effects of soil conditions on underground					
cables					
VI-B. Conductor installation techniques					
1) Different wiring methods for particular					
conductors and situations					
a) Wire connectors					
b) Types, installation, limitations					

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VI. CONDUCTORS (cont.)					
2) Different methods of installing conductors in conduits, raceways and cable trays					
a) Problems which may be encountered					
b) maximum tension allowed					
c) Use of pulling machines to assist in installation of conductors					
3) Proper splicing methods and techniques for various conductors and locations					
VI-C. Methods for selecting conductors					
1) Using code to determine type of conductor to use in a particular situation					
2) Using mathematical calculations to determine current carrying capacity of conductors					
3) Calculating or selecting cable ampacity from N.E.C. tables					
4) Loads for sizing conductors					
5) Code requirements depending on type of circuits and loads (lighting, appliance, heating, service entrance)					
VI-D. Cable fault situations					
1) The types and causes of cable faults					
2) Methods and equipment for locating cable faults including terminal tracing and magnetic detection					

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VII. CONDUIT, RACEWAYS, PANELBOARDS AND SWITCHBOARDS					
VII-A. Terms associated with conduits and raceways					
VII-B. Conduit and wiring support systems recognized by code					
1) Select appropriate conduit type					
2) Select and utilize appropriate connectors					
3) Select and utilize appropriate fastening devices and reinforcements					
4) Special considerations					
VII-C. Procedures for laying out various types of bends					
1) Take-up and gain					
2) Kicks and offsets					
3) Calculate degrees					
4) Back-to-back bends					
5) Determine overall length of conduit for specific situations					
6) Locating bending points					
7) Four techniques for segment bending					
8) Techniques and operations for making concentric bends					
9) Radius of a circle					
VII-D. Procedures for making bends when fabricating conduits					
1) Hand benders to make small bends on small diameter conduit					
2) Power benders to make bends on larger diameter conduit					
a) Make offsets using "constants" or "shrink" methods					

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VII. CONDUIT, RACEWAYS, PANELBOARDS					
AND SWITCHBOARDS (cont.)					
b) Make bends in proper sequence,					
direction and with necessary					
accuracy					
VII-E. Fabricating raceways and wiring support					
systems					
VII-F. Cable assembly wiring methods recognized by					
the N.E.C.					
VII-G. Function, operation and requirements for					
various panelboards and switchgear					
1) Installation of panels					
2) Installation of components					
3) Wiring and connectors					
4) Special considerations and occupancies					
VIII. LIGHTING SYSTEMS					
VIII-A. Function, operation and characteristics of					
various lighting systems					
1) Incandescent					
2) Fluorescent					
3) High Intensity Discharge					
4) Low voltage					
VIII-B. Lighting distribution and layout					
VIII-C. Installation and connection of fixtures					

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IX. OVERCURRENT DEVICES					
IX-A. Function, operation and characteristics of overcurrent protection devices					
1) Purpose and location of devices					
2) Three considerations necessary for the electrical component					
3) Interrupting ratings					
4) Short circuit currents					
5) Overload and overcurrent situations					
6) 10 and 25 foot tap rules					
7) Operation and application of fuses					
a) Single element and time delay					
b) The effects of heat					
8) Operation and application of various types of circuit breakers (e.g. molded case, air break)					
9) Utilize Peak-Let-Thru charts and table					
10) Function, operation and characteristics of ground fault circuit interrupters					
11) Function, operation and characteristics of surge protectors					
12) Appropriate devices for situation and according to code					
X. GROUNDING SYSTEMS					
X-A. Functions, operation and characteristics of grounding systems					
1) Reasons for grounding					
2) General types of faults					
3) Grounding electrode systems					

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X. GROUNDING SYSTEMS (cont.)					
X-B. Sizing, layout and installation of grounding systems					
1) N.E.C. requirements and interpretations					
2) Size of conductors and electrodes					
3) Installation of electrodes					
4) Installation of conductors and connection to electrodes					
5) The impact of soil conditions on earth grounding systems and equipment					
6) Principles and procedures of earth resistance testing					
7) Determine when ground fault protection is required					
X-C. Difference between insulation, isolation and elevation					
X-D. Difference between grounding, grounded, and bonding					
X-E. Special circumstances					
1) Systems over 1,000 volts					
2) Separately derived systems					
3) Buildings sharing service					
XI. PRINTS AND SPECIFICATIONS					
XI-A. Creation of blueprints, plans, and specifications					
1) Utilize symbols used in electrical and related trades					
2) Recognize functions of basic line types					
3) Identify drawing tools and techniques					
a) Orthographic views					
b) Types of projections					

4) Recognize and apply dimensions					
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XI. PRINTS AND SPECIFICATIONS (cont.)					
5) Prepare "as built" drawings					
6) Differences between wiring diagrams, line diagrams, schematics, and ladder diagrams					
a) Given schematics complete wiring diagrams					
b) Given panels and equipment layouts create drawings showing conduits and conductors using appropriate scale					
XI-B. Use of blueprints, plans, and specifications					
1) Recognize function of various types of plots, sections, details, schedules, specification sheets, addendums and revisions					
2) Determine devices, locations, quantities, feeds, conduit types and sizes and conductor sizes					
a) Parts of the electrical service					
b) Identifying special purpose outlets and the loads they serve					
c) Completing take-off sheets for ordering material					
d) Determine costs for jobs					
e) How costs affect jobs					
3) Interpret non-electrical dimensions and considerations					
4) Relationships between architectural considerations and electrical installations					
5) Correlate information from other trades plans with electrical plans to determine					

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XII. MOTORS, MOTOR CONTROLLERS AND PROCESS CONTROLLERS					
XII-A. Function, operation and characteristics of various types of motors(AC,DC,dual voltage repulsion, universal, 3 phase, squirrel cage, synchronous)					
1) Physical parts of various motors					
2) Utilize information sheets, plans, schematics, and motor nameplates to gain information					
3) Motor Losses					
4) Starting and operating characteristics					
5) Methods to identify windings in DC motor					
6) Means for providing field failure, current limit, voltage and speed control					
7) Block diagrams to demonstrate power supplies, armature, field and control features					
8) Torque, locked rotor current, no-load speed, and slip					
9) Reasons for low voltage starting					
10) Function, operation and characteristics of stepping motors					
XII-B. Proper techniques for motor installations					
1) Necessary calculations for electrical requirements per code					
2) Correct power factor					
3) Proper wire type and size					
4) Appropriate connections					
5) How various motors can be made to run at a different speed or direction					
a) Schematics					
b) Connections top reverse or change					

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XII. MOTORS, MOTOR CONTROLLERS AND PROCESS CONTROLLERS (cont.)					
XII-C. Function, operation and characteristics of motor controllers, circuits and devices					
1) Ways and means of starting and stopping motors					
2) Operation of a magnetic coil					
3) Use of magnetic starters and controllers					
4) Correct sizing of magnetic starters and controllers					
5) Difference between starters and contactors					
6) Function, operation, and characteristics of overload protective devices					
7) Schematics for various control circuits					
8) Two-wire control					
9) Three-wire control circuits					
10) Interlocking methods					
11) Reversing and sequential controllers					
12) Jogging, inching, plugging					
13) Multiple start-stop controls and selector switches					
14) Phase failure relays					
15) Various manual and automatic speed control techniques					
16) Function, operation, and characteristics of variable frequency drive systems					
17) Function, operation, characteristics and installation procedures, programmable logic controllers					
a) Function of central processing unit					
b) Memory types and sizes					
c) User and storage memory					
d) Back-up batteries					

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XII. MOTORS, MOTOR CONTROLLERS AND PROCESS CONTROLLERS (cont.)					
18) Ladder diagrams					
19) Function, operation, and characteristics of timers, counters, sequencers					
20) Utilize appropriate manual and information for start-up, maintenance and testing					
21) Utilize schematics for manual starters, automatic starters, speed regulators, and controllers					
XII-D. Function, operation and characteristics of switches and relays					
1) Schematic including switches and relays					
2) Installation and connection methods for various switch types					
3) Installation and connection methods for various relays					
4) Function, operation and characteristics of electronic sensor and pilot devices					
5) Function, operation and characteristics of control transformers					
a) leads of control transformers					
b) proper sizing of control transformers					
XII-E. Mechanical connections to utilize motors					
1) Operation of mechanical clutches and magnetic drives					
2) Direct and offset drives					
3) Proper pulley sizes required					
XII-F. Process control systems and devices					
1) Operating requirements followed by					

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XII. MOTORS, MOTOR CONTROLLERS AND PROCESS CONTROLLERS (cont.)					
2) Function, operation, characteristics and installation of:					
a) closed loop and open loop systems					
b) Feedback control					
c) Proportional control					
d) Integral control					
e) Derivative control					
3) Block diagrams, including control and devices					
4) The function, operation, characteristics of sensors and transmitters					
XIII. GENERATORS AND POWER SUPPLIES					
XIII-A. Principles of electromotive force					
XIII-B. Principles of generating electricity					
1) Parts, functions, operation and characteristics of the AC generator					
2) Parts, functions, operation and characteristics of the DC generator					
3) "left hand rule" for generators					
4) RPM, frequency and number of poles in a given generator					
5) 3 phase generation					
6) Wye and Delta windings					
7) 3 phase sine wave					
XIII-C. Types and configurations of uninterruptible power supplies (UPS)					
XIII-D. Types and configurations of battery systems used for UPS systems					

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XIV. TRANSFORMERS					
XIV-A. Function, operation, and characteristics of transformers					
1) Electrical principles involved in transformer operation					
2) Transformer classifications and applications					
3) Transformer losses					
4) Ratios for voltage and amperage with respect to number of turns					
XIV-B. Selection and installation of transformers					
1) Nameplate information					
2) Techniques for sizing transformers (single and three phase)					
3) Determining if given transformer meets voltage, current, and impedance requirements					
4) Calculating voltages and currents for load and windings					
5) Determining whether to use wye or delta wiring schemes					
6) Steps for receiving and preparing transformer for installation					
7) Necessary test to assure proper operation					
8) Proper techniques for power and load conductors					
9) Methods for determining proper type and values of electrical protective device					
10) Proper grounding procedures					

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XIV. TRANSFORMERS cont.)					
XIV-C. Distribution systems					
1) Functions, operation and characteristics of various types of distribution systems					
2) Criteria for selecting particular type of distribution system					
XV. PERSONAL DEVELOPMENT					
XV-A Orientation					
1) Make up and organization of the industry					
a) Jobsite chain of command					
(1) owner/customer					
(2) architects/engineers					
(3) inspection authorities					
(4) construction managers					
(5) general contractors					
(6) other contractors and trades					
2) Organizations within the industry					
a) manufacturers					
b) distributors					
XV-B. Methods of working with others					
1) The three basic methods of motivation					
2) Need levels of humans					
3) The role of supervisors					
a) leadership styles appropriate to					
certain situations					
b) need for competent supervisors					
4) Effective communications					
a) importance of communications in the					
industry and on the job					
b) barriers to communications					
c) keys to effective communications					

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XV. PERSONAL DEVELOPMENT (cont.)					
XV-C. Economic considerations					
1) Why worker future is tied to employer's					
2) Responsibilities of employer					
a) keeping skills current					
b) managing your future					
3) Costs of doing business					
4) Importance of satisfying customers					
5) Impact of job performance, behavior and appearance on prospects for future work					
6) Functions of marketing					
XVI. JOBSITE MANAGEMENT					
1) Coordinating tool needs with office of other jobs					
2) Coordinating schedule with other crafts					
3) Developing timetables and progress charts					
4) Completing time sheets, logs and other necessary documentation					
5) Clearances or permits if necessary					
6) Inventory and other necessary equipment according to job needs					
7) Developing alternative solutions and choose the best alternative					
8) Planning and organizing tasks to meet deadlines					
9) Supervising and monitoring others					
10) Picturing the way the project will appear when completed					

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XVII. TESTING					
XVII-A. Steps used for various testing processes					
1) Acceptance testing of cables					
2) Maintenance testing of generators					
3) Insulation tests using megohmmeter					
XVII-B. Utilizing the results of testing procedures					
1) Special requirements for high voltage testing					
2) Describe potential safety hazards					
3) Characteristics and properties of high voltage cable and insulators					
4) Appropriate tests, methods, voltages, and equipment					
XVIII. SPECIALTY SYSTEMS					
XVIII-A. Fire Alarms					
1) Functions, operations and characteristics of various types of fire alarm systems and components					
2) Code requirements and use code to answer specific questions					
3) The functions, operation, and characteristics of alarm initiating and indicating devices					
4) Multiplexing of system components					
5) Various types of areas and methods to protect them					
6) Appropriate wiring methods and devices					
7) Utilize manuals to start-up and check out system					
8) Utilize proper manuals and techniques					

for system maintenance and trouble-shooting					
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XVIII. SPECIALTY SYSTEMS (cont.)					
XVIII-B. Security Alarms					
1) Functions, operations and characteristics of various types of security systems and components					
2) Code requirements and use code to answer specific questions					
3) The functions, operation, and characteristics of alarm initiating and indicating devices					
4) Multiplexing of system components					
5) Various types of areas and methods to protect them					
6) Appropriate wiring methods and devices					
7) Utilize manuals to start-up and check out system					
8) Utilize proper manuals and techniques for system maintenance and trouble-shooting					
XVIII-C. Voice, Data, TV, Signaling Systems					
1) Functions, operation and characteristics of various types of voice, data, TV and signaling systems					
2) The proper cabling systems required for various systems (telephone, data, Local Area Networks, etc.)					
3) Installation and connection techniques for cables and devices					
4) How cable defects and installation errors can degrade system					
5) Utilize manuals to install, test and start					

6) Utilize proper manuals and techniques for system maintenance and troubleshooting					
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XVIII. SPECIALTY SYSTEMS (cont.)					
XVIII-D. Lightning Protection Systems					
1) Functions, operation and characteristics of lightning protection systems					
2) The sizing, layout and installation of lightning protection systems					
3) NEC requirements and interpretations					
4) Size of conductors and electrodes					
5) Installation of electrodes					
6) Installation of conductors and connections to electrodes					
XVIII-E. Fiber Optic Systems					
1) Functions, operation and characteristics of fiber optic cable					
2) Proper installation techniques					
a) minimum bend radius					
b) pulling techniques					
c) installation hardware					
d) splicing and termination					
3) Utilize appropriate manuals and equipment to perform system tests and troubleshooting					
XVIII-F. Heating, Air Conditioning and Refrigeration					
1) The function, operation and characteristics of heating, air conditioning and refrigeration systems					
2) Utilize appropriate manuals and equipment to perform system test and troubleshooting					

