College of Agriculture and Applied Sciences

Assessment Plan for

Electrical Apprenticeship

2021

Apprentice ElectricianAssessment

PROGRAM DESCRIPTION

An electrician apprentice is someone who works under a licensed electrician in order to learn the trade through first-hand experience. Most states require aspiring electricians to take a formal course through a trade school or technical college. In some instances, students may become an electrician's apprentice during school as part of their training. The USU Eastern Electrical Apprentice Program will give the student the skills and experience to become a journeyman electrician.

Utah State University Eastern's Electrical Apprenticeship program is designed for students working as apprentice electricians to advance to journeyman electrician. The course of study provides all of the classroom and lab experience necessary to advance from apprentice to journeyman in four years.

All classwork for the program is offered in the evening to allow students to complete their required on-the-job training while also completing the classroom requirements. Students will gain experience in electrical theory, National Electrical Code (NEC), and practical work applications, and all class and lab work are supervised by certified master and journeyman electricians.

To receive a license, the students need to take eight (8) courses, each 5-credit hours in length. The courses are taught in an exact sequence in the fall and spring semesters.

Fall Semester
APPR 2301 - Electrical Apprentice 1-A (yr 1)
APPR 2303 - Electrical Apprentice 2-A (yr 2)
APPR 2310 - Electrical Apprentice 3-A (yr 3)
APPR 2410 - Electrical Apprentice 4-A (yr 4)

Spring Semester
APPR 2302 - Electrical Apprentice 1-B (yr 1)
APPR 2304 - Electrical Apprentice 2-B (yr 2)
APPR 2320 - Electrical Apprentice 3-B (yr 3)
APPR 2420 - Electrical Apprentice 4-B (yr 4)

The program is offered only in the evenings to an enrollment limited by shop space and equipment access. A maximum of 20 students enroll in the program per year. The program is taught by two certified, master electricians with more than 25-years of industry experience.

A program completer is known as a Journeyman Electrician. A program completer can earn an Associates of Applied Science degree if they also complete the

required General Education courses. Few, very few, student's pursue that pathway.

All students complete a program regulated by the Utah Division of Occupational and Professional Licensure (DOPL). The DOPL is the state administered program for many professional licenses, such as building inspector, funeral services, nursing, and psychology. USU Eastern does not set the educational standards. USU Eastern meets those standards through a rigid curriculum review process by DOPL every three years.

The educational standards for the Apprentice Electrician program are based upon DOPL policyR156 - Commerce, Occupational and Professional Licensing. Specifically, R156-55b-101 are the rules for Electrician Licensing. This rule is known as the "Electricians Licensing Act Rule".

For the Apprentice Electrician program and R156-55b-101, electrical work includes installation of raceway systems used for any electrical purpose, and installation of field-assembled systems such as ice and snow melting, pipe-tracing, manufactured wiring systems, and the like. Electrical work does not include installation of factory-assembled appliances or machinery that are not part of the premises wiring unless wiring interconnections external to the equipment are required in the field, and does not include cable-type wiring that does not pose a hazard from a shock or fire initiation standpoint as defined by Title 15A, State Construction and Fire Codes Act.

USU Eastern provides an approved Apprentice Electrician program. The program of electrical study is approved by the Utah Board of Regents, Utah System of Technical Colleges Board of Trustees or other out of state program that is deemed substantially equivalent as determined by the Electricians Licensing Board. The program is also approved by the Electricians Licensing Board. The program provides at least 81 hours of classroom instruction per semester. A student attends a minimum of 72 hours to receive credit for the semester. A competency exam is given to each student at the end of each semester with the exception of the fourth year, second semester. A student, to continue to the next semester, is required to achieve a score of 75% or higher on the competency exam. A student who scores below 75% may retake the test one time. USU Eastern students are expected to pass each class with a minimum score of 75%.

In order to earn the DOPL license as a residential journeyman, the following skills and experience are required:
••
- Show proper use of test equipment.
- Calculate requirements/loads for motors and circuit conductors.
- Demonstrate knowledge and understanding of motor control circuits (including drawings/line or ladder diagrams), various motor control devices, relays and contactors and motor starters.
- Understand and use National Electrical Code (NFPA 70) 2014 edition.
- Complete at least 4000 hours in raceways, boxes and fittings, conduit,

wireways, cableways and other raceways and associated fittings, and non-metallic sheathed cable
- Complete at least 800 hours in wire and cable, individual conductors and multiconductor cables
- Complete at least 400 hours in distribution and utilization equipment including transformers, panel boards, switchboards, control panels, disconnects, motor starters,lighting fixtures, heaters, appliances, motors and other distribution and utilization equipment; and
- Complete at least 400 hours in specialized work including grounding, wiring of systems for sound, data, communication, alarms, automated systems, generators, batteries and computer equipment.

The teaching material comprises of the Mike Holt teaching curriculum.
- Mike Holt's Basic Electrical Theory 3rd Edition Leesburg: Mike Holt Enterprises, Inc., ISBN 978-1-932685-39-8, 2011
- National Electrical Code 2014 Edition Batterymarch Park: National Fire Protection Association, ISBN 978-145590672-7,
- 2013 Digital Multimeter Principles, 4th Edition Orland Park: American Technical Publishers, ISBN 978-0-8269-1506-1,
- 2010 OSHA Construction Safety Handbook, 6th Edition Neenah: J.J. Keller & Associates, ISBN 97978-1-60287-891-4, 2014
- Mike Holt's Illustrated Guide to Electrical Exam Prepartaion Leesburg: Mike Holt Enterprises, Inc., ISBN 978-1-932685-67-1, 2014
- Mike Holt's Illustrated Guide to Electrical Estimating 2nd Edition Leesburg: Mike Holt Enterprises, Inc., ISBN 978-1-932685-50-3, February 2012
- Mike Holt's Business Management Skills Workbook, 2nd Edition Leesburg: Mike Holt Enterprises, Inc., ISBN 978-1-932685-25-1, 2013
- Mike Holt's Illustrated Guide to Essential Rules of the NEC, based on the 2014 NEC Leesburg: Mike Holt Enterprises, Inc., ISBN 978-1-932685-66-4
- Mike Holt's Illustrated Guide to Understanding the NEC Volume 1 Leesburg: Mike Holt Enterprises, Inc, ISBN 978-1-932685-76-3, 2014

We use this particular text material because it is 1) Easy to understand. The text simplifies difficult technical topics and includes clear, step-by-step, detailed explanations. 2) Visual. It contains full-color, detailed, instructional graphics that help students visualize what's being taught. 3) Effective. It provides the instructor with resources that give them tools to be more successful in reaching their students.

LEARNING OBJECTIVES

Year 1
The first year introduces apprentices to the principles associated with electricity, electrical theory, and the basics of electrical systems. These basic fundamentals are necessary in understanding complex National Electrical Code requirements covered

throughout the program. In the latter part of the first year students will begin utilizing the National Electrical Code and be introduced to electrical theory pertaining to Grounding and Bonding as it relates to Article 250 in the NEC. Upon successful completion students should be able to:

- Identify hazards associated with electricity and in the construction field
- Understand The need for Safety Programs and Training
- Discuss methods of minimizing or eliminating the potential for hazards when working around electricity
- Safely use digital multi-meters to test circuits for the presence of voltage
- Understand the components of matter and their electrical properties
- Analyze basic electrical circuits (series, parallel, and series-parallel)
- List advantages of utilizing alternating current
- State the operation and purpose of overcurrent and ground fault protection
- Explain inductance and capacitance as well as their respective reactance
- Understand the components of matter and their electrical properties
- Calculate unknown values using Ohm's Law
- Explain the purpose of the National Electrical Code and its arrangement
- Understand terms as used in the National Electrical Code
- Understand the fundamental concepts of Grounding and Bonding as related to Article 250 in the NEC

Year 2

The second year focuses on the first four chapters of the NEC. Some equipment specific to alternating current will be introduced. Residential and commercial wiring methods and practices will also be covered in depth during the second year. Upon successful completion students should be able to:

- State the operation and purpose of overcurrent and ground fault protection
- Understand the components of matter and their electrical properties
- Analyze basic electrical circuits (series, parallel, and series-parallel)
- Calculate unknown values using Ohm's Law
- Explain the purpose of the National Electrical Code and its arrangement
- Understand terms as used in the National Electrical Code
- Lay out electrical equipment in accordance with required working space
- Demonstrate proficiency referencing Code articles in the general requirements
- List locations requiring ground-fault and arc-fault protection
- Determine required locations of receptacle and lighting outlets in dwelling units
- List types of overcurrent protection and their standard ratings

Year 3

The third year focuses on common industrial applications, methods, and requirements. While motors and controls are the major focus area, hazardous locations, special applications, Solar Photovoltaic Systems and Power Quality are also introduced. Upon successful completion students should be able to:

- Read prints on industrial and hazardous locations
- Perform work correctly from blueprints

- Wire control circuits from schematics
- Discuss the basic principles of motors and controls
- Identify variable frequency drives and programmable logic controllers
- Connect various two- and three-wire control circuits
- Show an understanding of control circuit components and their operation
- Define harmonics and explain their effects on electrical systems
- Understand The hazards of portable electric tools
- Understand the basic NEC Rules that apply to Solar PV
- Identify conductor and circuit parts as it pertains to NFPA 70E

Year 4

The fourth or final year of the program covers advanced Code calculations in great detail. Electrical estimating is discussed in the first part of the year as well as a review of electrical theory and motor controls. A review of the essential NEC rules will also be covered as well as electrical safety. Upon successful completion students should be able to:

- Determine labor and material extensions
- Properly prepare an estimate, bid, and proposal
- Perform calculations related to transformers, motors, air conditioning, and voltage drop
- Size branch circuits and feeders for motors and transformers
- Demonstrate an ability to properly apply the general tap rules as they apply to transformer secondary conductors
- Demonstrate an understanding of fire alarm circuits and systems
- Calculate commercial services, feeders, and branch circuits
- Size pull boxes correctly when working with large conductors
- Calculate proper conductor and overcurrent protection sizes for various types of circuits and loads
- Perform all service, feeder, and branch circuit calculations for dwelling units
- Properly size overcurrent protection for dwelling unit services and select the proper service cable size for a given set of values
- Successfully complete a simulated journeymen's exam

The end result of this program is that the student will be able to pass the DOPL license as a residential journeyman.

ASSESSMENT PLAN

The assessment plan for all four years comprises of the following -
Methods of assessment may include projects, quizzes, exams, in or out of class activities, and class participation.

Item	% of Grade
Participation	10%
Projects & Assignments	10%
Quizzes	30%
Exams	40%
Labs	10%
Total	100%

See Attachment A for sample test and quiz

Student assessments are an important aspect of the learning process. Studies have shown that regardless of the result, students who are required to mentally recall a subject upon review, are more likely to remember the content than those who didn't have this opportunity. Our program includes different options for assessment including, textbook review questions and exams.

Exams and quizzes are the primary source for student assessment of material knowledge. The lab component is done on the job work site and is tertiary to the in-class experience.

The exams and quizzes are designed to test the student's knowledge that has been taught in class lecture and discussion and acquired through the textbook questions. The exams, quizzes, and assignments test the students understanding of the learning objectives.

OUTCOME DATA

We track various data sets to help us better understand outcome data for the four-year program. The first data set is the programs drop rate, and more specifically, when during the program that a student unenrolls from the program (see chart C below). 42% of students unenroll from the program after the first semester. We have surveyed many of the students to better understand why. The number one reason is insufficient math skills. The number two reason is that the student was not able to be hired by a local employer as part of the state apprenticeship requirement.

Chart C
Enrollment/Drop Data

	Enrolled	Dropped after 1st semester	Drop rate	Dropped anytime during program	Program drop rate	Completed after 4 yrs.	Projected to complete	Completion Rate
2015	6	2	33%	1	50%	3		50%
2016	16	9	56%	2	69%	5		31%
2017	13	4	31%	5	69%	4		31%
2018	12	5	42%	2	58%	ND	5	42%
2019	23	8	35%	6	61%	ND	9	39%
2020	19	10	53%	ND	ND	ND	9	50%
Total	89	38	42%		61%	(ND=No Data)		40%

Of those remaining students, approximately 20% drop during the course over the next four years for an average program completion rate of 40%, which is the next data set we track. On average the number of completers is 40% of the cohort.

That leads into the next data set we track. We compare our completion rate to the state and national averages. As a comparison, the national completion rate for apprenticeships is 13%, and the State of Utah is 15% (https://www.dol.gov/agencies/eta/apprenticeship/about/statistics/2020). Though the number seems low, USU Eastern's completion rate is three times the national and state average. Our goal is to maintain a completion rate of 40% and above.

ACTION PLAN

Through this process we have identified three areas we can improve to better assess the programs impact on students. We believe these action items will lead to a better student experience and a higher completion rate.

1 – We know a high number of students unenroll during or after the first semester. The number one cause is inadequate math skills. We are going to implement a Wide Range Assessment Test (WRAT) assessment through the Aggie Center for Enrichment (ACE) as a prerequisite for the course. The WRAT test will assess the student's math skills and identify any student that does not meet the minimum requirement. This does not mean that the student will be automatically withdrawn, but it does mean they will need to receive additional assistance from the ACE tutors if they are to be successful in the program.

2 – Strengthen our PAC and industry partner relations. The second most common

reason for withdrawal is that the student is not able to find employment in the industry. By strengthening partner relationships, we will be able to identify which companies have potential opportunities. These opportunities can then be shared with those students that have not found an industry apprenticeship.

3 – Though we do survey those students that drop in the first semester, we do not survey students that drop after the first semester. The students that drop after the first semester comprises approximately 20% of the total student drop base. By surveying these additional students we will better understand the reason they unenroll. From this we will implement additional safety nets to enhance the students learning experience and success rate.

ATTACHEMENT A

Sample Test
APPR 1B   **FINAL**

True/False Indicate whether the statement is true or false.

1. DC power is determined by multiplying the electromotive force by the circuit intensity.
2. The voltage applied to a resistor does not affect the power consumed by the resistor.
3. In a parallel circuit, the voltage drop across each resistance is equal to the sum of the voltage drops of each of the resistors in parallel.
4. In a parallel circuit, the total circuit resistance is always greater than the smallest resistance.
5. A multiwire circuit has two or more ungrounded conductors having a potential difference between them, and having an equal difference of potential between each ungrounded conductor and the neutral conductor.
6. Resistance opposes the flow of electrons. In a series circuit, the total circuit resistance is equal to the sum of all of the resistances in series.
7. A parallel circuit has two or more paths in which current may flow.
8. The opening time for a protection device is inversely proportional to the magnitude of the current. The greater the current value, the less time it takes for the protection device to open.
9. Circuit breakers and fuses are intended to interrupt the circuit, and they must have an ampere interrupting rating (AIR) sufficient for the available short-circuit current.
10. Unless marked otherwise, circuit breakers have a 5,000 AIC rating and fuses have a 10,000 AIC rating.
11. Every component of an electrical circuit contains resistance, except the power supply.
12. Smaller conductors have greater resistance and larger conductors have lower resistance.
13. Aluminum has a lower resistance to the flow of electrons than does copper.
14. Multiwire branch circuits have more conductors for a given number of circuits, which requires the use of a larger raceway.
15. When a magnetic field moves through a coil of wire, the lines of force of the magnetic field cause the electrons in the wire to flow in a specific direction. When the magnetic field moves in the opposite direction, electrons in the wire flow in the opposite direction.
16. A simple ac generator consists of a loop of wire rotating across the lines of force between the opposite poles of a magnet.
17. Effective ac voltage or effective ac current is the equivalent value of dc voltage or dc current that would produce the same amount of heat in a resistor.
18. When electrons are forced to move through a conductor, the magnetic fields of individual electrons subtract from one another.
19. If an atom contains more electrons than protons, the atom has a negative atomic charge.

Multiple Choice Identify the choice that best completes the statement or answers the question.

20. Ohmmeters measure the _____ or opposition to current flow of a circuit or component.
a. voltage
b. current
c. power
d. resistance

21. The megger is used to measure very high-_____ values, such as those found in cable insulation, or motor and transformer windings.
a. voltage
b. current
c. power
d. resistance

22. What is the voltage drop of two 12 AWG conductors (0.40 ohm)supplying a 16A load, located 100 ft from the power supply?
Formula: EVD = I x R
a. 6.4V
 b. 12.8V
c. 1.6V
d. 3.2V

10

23. What is the resistance of the circuit conductors when the conductor voltage drop is 7.2V and the current flow is 50A?
a. 0.14 ohm
b. 0.30 ohm
c. 3 ohm
d. 14 ohm

24. What is the power loss in watts of a conductor that carries 24A and has a voltage drop of 7.2V?
a. 175W
b. 350W
c. 700W
d. 2,400W

25. The total circuit resistance of two 12 AWG conductors (each 100 ft long) is 0.40 ohm. If the current of the circuit is 16A, what is the power loss of the conductors in watts?
a. 75W
b. 100W
c. 300W
d. 600W

26. What does it cost per year (at 8 cents per kWh) for the power loss of a 12 AWG circuit conductor (100 ft long) that has a total resistance of 0.40 ohm and current flow of 16A?
a. $30
b. $50
c. $70
d. $90

27. The opposition to current flow results in voltage drop.
a. true
b. false

28. Kirchoff's Current Law states that in a series circuit, the current is _____ through the transformer, the conductors, and the appliance.
a. proportional
b. distributed
c. additive
d. the same

29. A balanced 3-wire, 120/240V, single-phase circuit is connected so that the ungrounded conductors are from different transformer phases (Line 1 and Line 2). The current on the neutral conductor will be percent of the ungrounded conductor current.
a. 0
b. 70
c. 80
d. 100

30. If the ungrounded conductors of a multiwire circuit are not terminated to different phases, this can cause the neutral current to be in excess of the neutral conductor rating.
a. true
 b. false

31. The purpose of overcurrent protection is to protect the conductors and equipment against excessive or dangerous temperatures because of overcurrent. Overcurrent is current in excess of the rated current of equipment or conductors. It may result from a(n) _____.
a. overload
b. short circuit
c. ground fault
d. all of these

32. Inverse time breakers operate on the principle that as the current decreases, the time it takes for the device to open decreases.
a. true
b. false

33. If the protection device is not rated to interrupt the current at the available fault values at its listed voltage rating, it could explode while attempting to clear the fault.
 a. true
 b. false

34. A GFCI is designed to protect persons against electric shock. It operates on the principle of monitoring the imbalance of current between the circuit's _____ conductor.
a. ungrounded
b. grounded
c. equipment
d. a and b

35. An AFCI protection device provides protection from an arcing fault by recognizing the characteristics unique to an arcing fault and by functioning to de-energize the circuit when an arc fault is detected.
a. true
b. false

36. The effective value is equal to the peak value _____.
a. times 0.707
b. times 1.41
c. times 2
d. times 3

37. The opposition offered to the flow of ac current by a capacitor is called capacitive reactance, which is expressed in ohm and abbreviated _____.
a. Xc
b. XL
c. Z
d. none of these

38. The total opposition to current flow in ac circuits is called _____ and measured in ohm.
a. resistance
b. reactance
c. impedance
d. skin effect

39. Electrical pressure is called _____, and it is measured in volts.
a. EMF
b. potential
c. a or b
d. none of these

40. In electrical systems, the volume of electrons that move through a conductor is called the circuit _____.
a. resistance
b. power
c. pressure
d. intensity

41. An overcurrent protection device (breaker or fuse) must be sized no less than 125 percent of the continuous load. If the load were 16A, the overcurrent protection device would have to be sized at no less than _____.
a. 20A
b. 23A

12

c. 17A
d. 30A

42. The maximum continuous load on an overcurrent protection device is limited to 80 percent of the device rating. If the overcurrent device is rated 100A, the maximum continuous load is _____.
a. 72A
b. 80A
c. 90A
d. 125A

43. The feeder demand load for an 8 kW load, increased by 20 percent is _____.
a. 8 kW
b. 9.60 kW
c. 6.40 kW
d. 10 kW

44. What is the power consumed in watts by a 12 AWG conductor that is 100 ft long and has a resistance (R) of 0.2 ohms, when the current (I) in the circuit is 16A? Formula: Power = I^2 x R.
a. 75W
b. 50W
c. 100W
d. 200W

45. What is the area in sq in. of a 2 in. raceway? Formula: Area = [pi symbol] x r2, [pi symbol] = 3.14 , r = radius, which equals 1/2 of the diameter.
a. 1 sq in.
c. 3 sq in.
b. 2 sq in.
d. 4 sq in.

46. What is the maximum distance that two 14 AWG conductors can be run if they carry 16A and the maximum allowable voltage drop is 10V? D = (CM x VD)/(2 x K x I) D = (4,110 CM x 10V)/(2 wires x 12.9 ohms x 16A)
a. 50 ft
c. 100 ft
b. 75 ft
d. 150 ft

47. What is the current in amperes of an 18kW, 208V, three-phase load? Formula: I = P/(E x ?3) 18,000 VA/(208V x 1.732)
a. 25A
c. 100A
b. 50A
d. 150A

48. What does it cost per year (at 9 cents per kWh) for ten 150W recessed luminaires to operate if they are turned on for six hours per day?
a. $150
c. $500
b. $300
d. $800

49. The decimal equivalent for the fraction "1/2" is _____.
a. 0.20
c. 2
b. 0.50
d. 5

50. The decimal equivalent for the fraction "4/18" is _____.
a. 0.20

c. 3.50
b. 2.50
d. 4.50

51. The decimal equivalent for "75 percent" is _____.
a. 0.075
c. 7.50
b. 0.75
d. 75

52. The decimal equivalent for "300 percent" is _____.
a. 0.03
c. 3
b. 0.30
d. 30.00

53. What is the reciprocal of 1.25?
a. 0.80
c. 1.25
b. 1.10
d. 1.50

54. What is the volume (in cubic inches) of a 4 x 4 x 1.50 in. box?
a. 20 cu. in.
c. 30 cu. in.
b. 24 cu. in.
d. 33 cu. in.

55. What is the kW of a 75W load?
a. 0.075 kW
c. 7.50 kW
b. 0.75 kW
d. 75 kW

56. The purpose of overcurrent protection is to protect conductors and equipment against excessive or dangerous temperatures because of overcurrent. Overcurrent is current in excess of the rated current of equipment or conductors. It may result from a(n) _____.
a. overload
c. ground fault
b. short circuit
d. all of these

57. A short circuit is a _____ electrical connection between any two conductors of the electrical system.
a. line-to-line
c. line-to-ground
b. line-to-neutral
d. a or b

58. Electrical pressure is called "_____," and it is measured in Volts.
a. EMF
c. a or b
b. potential
d. none of these

59. "_____" is defined as the rate of work measured by the unit called the watt.
a. Resistance
c. Pressure
b. Power

d. Intensity

60. What is the neutral current for a 4-wire, 120/208V circuit, where L1 = 20A, L2 = 20A, and L3 = 20A?
a. 0A
c. 20A
b. 10A
d. 60A

61. The output voltage of a generator depends upon the _____.
a. number of turns of wire
c. speed at which the coil rotates
b. strength of the magnetic field
d. all of these

62. The _____ wave is a waveform that is symmetrical with positive above and negative below the zero reference level.
a. nonsinusoidal
c. sine
b. nonsymmetrical
d. any of these

63. The number of complete waveforms in one second is called the "frequency." Frequency is expressed as "_____" or "cycles per second."
a. degrees
c. phase
b. a sine wave
d. Hertz

64. "_____" is the value of the voltage or current at a given moment of time.
a. Peak
c. Effective
b. Root-mean-square
d. Instantaneous

65. "_____" is the maximum value that ac current or voltage reaches, both for positive and negative polarity.
a. Peak
c. Instantaneous
b. Root-mean-square
d. none of these

66. "_____" describes the steps necessary to determine the effective voltage or current value.
a. Peak
c. Instantaneous
b. Root-mean-square
d. none of these

67. The peak value is equal to the effective value _____.
a. times 0.707
c. divided by 2
b. times 1.41
d. times 0.58

68. Voltmeters are connected in _____ with the circuit and measure the difference of potential between the two test leads.
a. series
c. series-parallel
b. parallel
d. none of these

69. DC ammeters of the direct connection type must be connected in _____ with the power source and the load. If connected

in reverse polarity, the coil will move in the opposite direction.
a. series
c. series-parallel
b. parallel
d. none of these

70. The stationary magnetic field of a dc motor, called a "_____," is a permanent magnet or an electromagnet.
a. winding
c. stator
b. rotor
d. none of these

71. The decimal equivalent for "225 percent" is _____.
a. 0.225
c. 22.50
b. 2.25
d. 225

72. The feeder calculated load for an 8 kW load, increased by 20 percent is _____.
a. 6.40 kW
c. 9.60 kW
b. 8 kW
d. 10 kW

73. The volume of an enclosure is expressed in _____, and it is calculated by multiplying the length, by the width, by the depth of the enclosure.
a. cubic inches
c. inch-pounds
b. weight
d. none of these

74. Atoms contain three types of subatomic particles: electrons, protons, and neutrons. The _____ orbit around the nucleus.
a. electrons
c. neutrons
b. protons
d. nuclei

75. The numeric equivalent of 4^2 is _____.
a. 2
c. 16
b. 8
d. 32

Sample Quiz

Quiz Chapter 5 Electromagnetism 47-50
When electrons are forced to move through a conductor, the magnetic fields of individual electrons are subtract from one another.
F

The field intensity around a conductor carrying current decreases with increased current flow, and is stronger the further the distance from the conductor.
F

If a conductor is twisted to form a loop, the electromagnetic fields around the conductor are compressed to create a dense and strong electromagnetic field.

T

Chapter 6 Quiz Uses of Electromagnetism 53-60

Voltmeters are connected in _____ with the circuit and measure the difference of potential between the two test leads
Series
<u>Parallel</u>
Series-Parallel
None of these

A clamp-on AC ammeter has a coil that is clamped around the conductor and detects the rising and falling _____ field being produced due to the as flow through the conductor.
Static
Current
Power
<u>Magnetic</u>

The stationary magnetic field of a dc motor, called a "_____," is a permanent magnet or a electromagnet.
Winding
Rotor
<u>Stator</u>
None of these

The _____ of a generator is forced to rotate while it is being subjected to the magnetic field of the stator.
Winding
<u>Rotor</u>
Stator
B or c

"Normally open" means that the contacts are open when the power is applied.
F

Unit 10 Series Circuits Quiz - 121-131
2. Series Circuits are often used for _____ applications.
Signal
Control
<u>A and B</u>
None of these

4. Resistance opposes the flow of electrons. In a series circuit, the total circuit resistance is equal to the sum of all the resistances in series.
T

Kirchhoff's Voltage Law states, "in a series circuit, the sum of the voltage drops across all of the resistors equals the applied voltage."
F

The power consumed in a series circuit is equal to the power consumed by the largest resistance in the series circuit.
F

To calculate the total resistance of the circuit: Rt = R1 + R2 + R3 ……….
T

There can never be variations in the formulas used or the order in which they are used for series circuits.

F

Unit 11 Parallel Circuits Quiz – 135-143
A parallel circuit has two or more paths in which current may flow.
T

The total power consumed in a parallel circuit equals the sum of the power of all branches.
T

The total resistance of a parallel circuit can be calculated by the _____ method.
Equal resistance
Product – over – sum
Reciprocal
<u>Any of these</u>

The product-over-sum method is used to calculate the resistance of _____ resistance(s) at a time.
One
<u>Two</u>
Thee
Four

Unit 12 Series-Parallel Circuits Quiz – 145-148
A _____ is a circuit that contains some resistances in series and some resistances in parallel with each other.
Parallel circuit
Series circuit
<u>Series-parallel circuit</u>
None of these

That portion of the series-parallel circuit that contains resistances in series must comply with the rules for series circuits
T

That portion of the series-parallel circuit that contains resistances in parallel must comply with the rules for parallel circuits.
T

When working with series-parallel circuits, it is best to redraw the circuit so you can see the series components and the parallel branches.
T

Unit 13 Mulitwire Circuits Quiz – 151-160
A 2-wire, 120V circuit, from a 2-wore system, contains _____.
A neutral conductor
A grounded conductor
Ungrounded conductor
<u>B and C</u>

The current on the grounded conductor of a 2-wire circuit is _____ of the current on the ungrounded conductor.
0%
70%
80%
<u>100%</u>

What is the neutral current for a 4-wire, 120/208V circuit, where L1 = 20A, L2 = 20A, and L3 = 20A?
<u>0A</u>
10A
20A
60A

18

The current flowing on the neutral conductor of a multiwire circuit is called "unbalanced current."
T

Multiwire branch circuits have more conductors for a given number of circuits, which requires the use of a larger raceway.
F

What is the voltage drop of two 12 AWG conductors, each 100 ft in length, supplying a 2-wire, 16A load? The resistance of 12 AWG conductors is 2 ohms per 1,000 ft.
3.20V
6.40V
7.20V
9.6V

Improper wiring or mishandling of multiwire circuits can cause _____ connected to the circuit.
Overloading of the ungrounded conductors
Overloading of the neutral conductors
Destruction of equipment because of over voltage
B and C