Electrical – Electronic – Control Engineering

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Refer to figures "1" and "2" of the basic synchronous transmission system shown in the illustration. Figure "1" shows a properly connected system where the receiver TR remains in correspondence with the transmitter TX. In figure "2", although properly zeroed, the receiver goes out of correspondence with the transmitter due to improper connections resulting in reverse torque direction. Which connection error results in this behavior? Illustration EL-0149
A

Illustrations: EL0149_AO_091611WM

A digital multimeter is set up as shown in the illustration to test an individual element of a three-phase immersion heater. The elements are connected across terminals 1 and 4, 2 and 5, and 3 and 6 as shown. The reading across terminals 1 and 4 is 32 ohms. The reading across terminals 2 and 5 is 32 ohms. The reading across terminals 3 and 6 as shown is "OL" ohms. What is condition is indicated? Illustration EL-0216
The element across terminals 3 and 6 is open-circuited. The other two elements are functioning properly.

Illustrations: EL0216_WM_060216
See REF1805

Refer to the diagram of the AC turboelectric drive system as shown in the illustration. The propulsion motor operates from maneuvering speed to full ahead speed in the ahead direction. The propulsion motor will not operate at any speed in the astern direction. What is most likely the problem? Illustration EL-0142
The reversing contactor (R) fails to pull in.

Illustrations: EL0142_AO_042715WM

As shown in figure "A" of the ungrounded distribution system with possible ground faults shown in the illustration, under what conditions would an outage likely occur due to a ground fault causing a circuit breaker to trip? Illustration EL-0129
two ground faults associated with different phases

Illustrations: EL0129_AO_031518WM

As shown in figure "A" of the illustration, what type of ground fault detection system is illustrated? Illustration EL-0132
a direct current injection system

Illustrations: EL0132_AO_042015WM

In order to properly set up programmable motor protection, it is necessary to know the locked rotor current of a motor. Given the chart of code letters for locked-rotor kVA/HP and the necessary instructions shown in the illustration, calculate the estimated locked rotor current for the motor represented by the illustrated motor nameplate using a mid-range value for the code letter, assuming the motor is to run at 440 VAC _____. Illustration EL-0175
43.7 amps

Illustrations: EL0175_AO_060216WM

As shown in figure "B" of the typical ground fault relay shown in the illustration, what statement concerning the leakage current setting adjustment is true? Illustration EL-0223
Setting the leakage current for too low a value may increase the likelihood of nuisance trips and setting the leakage current for too high a value may result in incidental damage due to a ground fault.

Illustrations: EL0223_WM_101118

In the circuit 'B' of the illustration, what would be the result of the upper heating element being burned out and open circuited? Illustration EL-0041
low heat (series) position would result in no heat at allmedium heat (single) position would result in no heat at allhigh heat (parallel) position would result in medium heat

Illustrations: EL0041_AO_030915WM

Refer to figure "A" representing an electric oven as shown in the illustration. With the oven turned on, the power available indicator light is off, the oven on indicator light is off, and only elements "6" and "7" appear to be producing heat. Which fuse is blown? Illustration EL-0041
L1 10A line fuse is blown

Illustrations: EL0041_AO_030915WM

As shown in figure "1" of the illustration, a correctly connected synchronous transmission causes the receiver to be in correspondence with the transmitter. If the receiver is out of correspondence, 180 degrees out of zero, but the torque direction is correct as shown in figure "2", what figure shows the incorrect connections responsible for this condition? Illustration EL-0150
B

Illustrations: EL0150_AO_091611WM

As shown in the illustrated wiring diagram for an engine order telegraph system, what statement concerning the constant ringing and trouble alarm is true? Illustration EL-0113
The constant ringing and trouble alarm sounds when the acknowledge handle and indicator arrow are not on the same order.

Illustrations: EL0113_AO_070715WM

If the values of "C1" and "R1" shown in the illustration were 1 microfarad and 3 megohms respectively, which of the listed intervals of time would equal one "time constant"? Illustration EL-0086
3 seconds

Illustrations: EL0086_WM_100518
See REF1808

In the schematic of the electrical circuit shown in figure "A" of the illustration, what is the value of the total capacitance, when compared to the value of equal individual capacitors? Illustration EL-0038
Double

Illustrations: EL0038_WM_100518, PARALLELCIRCUITS2641
See REF1821

If a circuit has resistances of 5, 10, and 20 ohms connected in parallel, what is the combined total resistance of the circuit?
2.9 ohms

Illustrations: PARALLELCIRCUITS1911
See REF1822

As shown in figure "A" of the illustration, what would be the circuit impedance if the capacitive reactance is 10 ohms and the resistance is 10 ohms? Illustration EL-0109
14.14 ohms

Illustrations: EL0109_WM_100918

In the schematic of the electrical circuit shown in figure "A" of the illustration, what is the value of the total capacitance, when compared to the value of equal individual capacitors? Illustration EL-0039
one half

Illustrations: EL0039_AO_091411WM
See REF1821

At a minimum threshold, how many milliamps of current through the body produces a painful sensation that most people would perceive as an electric shock?
3 to 7 mA

Illustrations: EFFECTS OF ELECTRICAL CURRENT

At a minimum threshold, how many milliamps of current through the body produces a condition where most people would experience respiratory paralysis and be unable to breathe while still in contact with the energized conductor?
30 mA

Illustrations: EFFECTS OF ELECTRICAL CURRENT

At a minimum threshold, how many milliamps of current through the body produces a condition where most people would be unable to let go of the energized electrical conductor due to involuntary muscular contraction?
10 to 16 mA

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Illustrations: EFFECTS OF ELECTRICAL CURRENT

At a minimum threshold, how many milliamps of current through the body produces a condition where most people would suffer ventricular fibrillation and could only be resuscitated with a ventricular defibrillator?
75 mA for 5 sec.

Illustrations: EFFECTS OF ELECTRICAL CURRENT

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75 mA for 5 sec.

Illustrations: EFFECTS OF ELECTRICAL CURRENT

As shown in figure "A" of the illustration, the load-commutated inverter drive illustrated has how many pulses? Illustration EL-0159
6

Illustrations: EL0159_AO_041718WM

As shown in the illustrated diagnostic setup checking for a reversed field pole on a ten-pole synchronous motor, if a rotor is being checked after reassembly and the steel bolts repel each other as shown in the illustration, what condition is indicated? Illustration EL-0205
Either coil 3 or coil 4 has a reversed polarity

Illustrations: EL0205_AO_051815WM

As shown in figure "A" of the illustration, with a digital multimeter set up as an ohmmeter, what set of readings would be consistent with an open in phase "B" of the single circuit, wye-connected stator windings as shown? Illustration EL-0201
T1 to T2: "OL ohms"; T2 to T3: "OL ohms"; T3 to T1: "1.8 ohms"

Illustrations: EL0201_AO_051815WM

Which of the following motors has a frame configuration for solid base mounting only? Illustration EL-0184
A

Illustrations: EL0184_WM_101018

In using a portable growler for the purpose of locating a shorted stator coil in an AC motor as shown in the illustration, what statement is true as the feeler is moved from slot to slot around the stator? Illustration EL-0200
The feeler will vibrate in synchronism with the 60 Hz AC power source and produce a growling noise when the feeler is moved over a slot containing a shorted coil.

Illustrations: EL0200_AO_051815WM

A digital multimeter is set up as shown in the illustration to evaluate the single-circuit stator windings of a squirrel cage induction three-phase motor. The following readings are taken: From T1 to T2 reads "OL" ohms. From T2 to T3 reads "OL" ohms. From T3 to T1 as shown reads "1.6" ohms. What condition is indicated? Illustration EL-0219
Phase A (associated with T1) and Phase C (associated with T3) are undamaged. Phase B (associated with T2) is open-circuited.

Illustrations: EL0219_WM_101118
See REF1805

As shown in the illustrated wound-rotor induction motor how is the direction of rotation of the motor reversed? Illustration EL-0148
Any two of the "T1, T2, and T3" leads are reversed only.

Illustrations: EL0148_WM_100918

As shown in the illustrated wound-rotor induction motor, what statement is true concerning motor lead connections? Illustration EL-0148
The "M1, M2, and M3" motor leads are connected to the rotor windings via slip rings and brushes and the "T1, T2, and T3" motor leads are directly connected to the stator windings.

Illustrations: EL0148_WM_100918

What are the operational characteristics of the split phase motor shown in figure "A" of the illustration? Illustration EL-0215
The motor is reversible and dual-voltage, configured for low volts.

Illustrations: EL0215_AO_051815WM

What are the operational characteristics of the split phase motor shown in figure "B" of the illustration? Illustration EL-0215
The motor is reversible and dual-voltage, configured for high volts.

Illustrations: EL0215_AO_051815WM

As shown in figures "A", "B", "C", and "D" of the illustration, what is the usual means by which the rotation direction of the motor is reversed? Illustration EL-0207
Interchanging leads T5 and T8

Illustrations: EL0207_WM_101018

Within the split phase family of single phase motors, what are the operational characteristics of the motor shown in figure "B" of the illustration? Illustration EL-0207
Relatively high starting torque and relatively low running efficiency

Illustrations: EL0207_WM_101018

As shown in figures "A", "B", "C", and "D" of the illustration, what is the usual means by which the rotation direction of the motor is reversed? Illustration EL-0207
Interchanging leads T5 and T8

Illustrations: EL0207_WM_101018

Within the split phase family of single phase motors, what are the operational characteristics of the motor shown in figure "A" of the illustration? Illustration EL-0207
Relatively low starting torque and relatively low running efficiency

Illustrations: EL0207_WM_101018

Which of the pictured motors within the split phase family of single phase induction motors represents a capacitor start, induction run motor? Illustration EL-0146
A

Illustrations: EL0146_AO_091611WM

Which of the pictured motors within the split phase family of single phase induction motors represents a split phase, resistive start, induction run motor? Illustration EL-0146
C

Illustrations: EL0146_AO_091611WM

According to the sample sheet of a typical "List of Motors and Controls" as shown in the illustration, which of the following motor applications features a means of keeping the motor windings warm and dry when the motor is idle? Illustration EL-0204
Amidship mooring winch

Illustrations: EL0204_AO_051815WM

Which of the following statements describes what will occur if the motor torque-speed and current-speed curves shown in the illustration is required to carry 150% of full load? Illustration EL-0056
The stator current will increase.

Illustrations: EL0056_WM_100518

The torque-speed and current-speed curves for a three-phase induction motor with a squirrel-cage rotor are shown in figures "A" and "B" of the illustration. Which of the following statements is true concerning the depicted curves? Illustration EL-0056
Starting current is approximately 4.75 times the normal full load current value.

Illustrations: EL0056_WM_100518

The torque-speed and current-speed curves for a three-phase induction motor with a squirrel-cage rotor are shown in figures "A" and "B" of the illustration. Which of the following statements is true concerning the depicted curves? Illustration EL-0056
Starting current is approximately 4.75 times the normal full load current value.

Illustrations: EL0056_WM_100518

Assuming that the 3-phase power source has a phase sequence of A-B-C and that the motor is connected as shown in figure "A", if the motor has a counterclockwise (CCW) rotation, what statement is true concerning the motors connected as shown in the other figures? Illustration EL-0156
Motors "B" and "D" would have a clockwise (CW) rotation and motor "C" would have a counterclockwise (CCW) rotation.

Illustrations: EL0156_AO_091611WM

Assuming that the 3-phase power source has a phase sequence of A-B-C and that the motor is connected as shown in figure "A", if the motor has a clockwise (CW) rotation, what statement is true concerning the motors connected as shown in the other figures? Illustration EL-0156
Motors "B" and "D" would have a counterclockwise (CCW) rotation and motor "C" would have a clockwise (CW) rotation.

Illustrations: EL0156_AO_091611WM

What type of motor is illustrated by the schematic of figure "B" of the illustration and what type of starting relay is used? Illustration EL-0209
capacitor start, induction run motor using a potential starting relay

Illustrations: EL0209_AO_051815WM

Which of the pictured motors is a square core shaded pole motor used to drive very small electrical loads and is non-reversible _____. Illustration EL-0208
B

Illustrations: EL0208_WM_101018

Which of the illustrated motors has an open, drip-proof (ODP) motor enclosure? Illustration EL-0001
C

Illustrations: EL0001_WM_100518

Which of the illustrated motors has an open motor enclosure? Illustration EL-0001
B

Illustrations: EL0001_WM_100518

Which of the illustrated motors has a totally enclosed, fan-cooled (TEFC) motor enclosure? Illustration EL-0001
A

Illustrations: EL0001_WM_100518

Which of the following illustrated circuit schematics provides phase failure protection for a three phase motor using load side current sensing technology? Illustration EL-0222
D

Illustrations: EL0222_AO_051815WM

As shown in the illustration, what type of motor is controlled as depicted in both figure "A" and in figure "B"? Illustration EL-0144
three phase wound rotor induction motor

Illustrations: EL0144_AO_100918WM

As shown in figure A" of the illustrated motor nameplate, how much current could the motor safely draw on a continuous basis at sea level without overheating? Illustration EL-0171
187 amps

Illustrations: EL0171_WM_101018

As shown in the illustration, using the instructions provided and Chart "A" and Table "24", what size overload relay heater would be the proper selection for the motor associated with the motor nameplate data shown assuming the motor operates at sea level and that the motor and its starter share the same ambient temperature? Illustration EL-0171
G30T20

Illustrations: EL0171_WM_101018

As shown in the two-speed single winding three phase motor connection diagrams illustrated in figure "B", what is the connection scheme associated with low speed operation? Illustration EL-0118
series delta

Illustrations: EL0118_AO_022818WM

As shown in the two-speed single winding three phase motor connection diagrams illustrated in figure "B", what is the connection scheme associated with low speed operation? Illustration EL-0118
series delta

Illustrations: EL0118_AO_022818WM

As shown in the two-speed single winding three phase motor connection diagrams illustrated in figures "B", "C", and "D", what type of motor is shown in the motor controller circuit illustrated in figure "A"? Illustration EL-0118
unable to determine whether the motor is a constant torque or variable torque motor

Illustrations: EL0118_AO_022818WM

As shown in the illustration, what type of motor and motor starter are featured? Illustration EL-0137
non-reversing squirrel cage induction motor with reduced voltage autotransformer starting

Illustrations: EL0137_WM_100918

Concerning figure "A" of the illustration, if the illustrated PLC ladder diagram is for a simple motor controller, what does "Input A" represent? Illustration EL-0236
normally open, momentary contact start pushbutton switch

Illustrations: EL0236_AO_052615WM

Which of the following pictures represents a magnetic reversing or two-speed motor starter? Illustration EL-0179
D

Illustrations: EL0179_WM_101018

As shown in figure "A" of the illustration, what is the purpose of the "test button"? Illustration EL-0178
The test button is used to mimic an overload to test the trip function of the overload relay.

Illustrations: EL0178_WM_060216

As shown in the illustrated feeder disconnect controller, what statement is true? Illustration EL-0138
the feeder disconnect contactor remains closed on a loss of power

Illustrations: EL0138_AO_100918WM

As shown in the illustration, what type of motor and motor starter are featured? Illustration EL-0136
squirrel cage induction motor with across-the-line starting

Illustrations: EL0136_AO_032618WM

As shown in the illustrated steering hydraulic pump motor controller, what statement is true? Illustration EL-0119
The pump motor is protected by low voltage release and protected from motor overload by visual warning

Illustrations: EL0119_WM_100918

In the illustrated solid-state "soft" starter for a three phase induction motor as shown in figure "A", what is the name of the devices that are controlled by the gate control circuits? Illustration EL-0060
thyristors

Illustrations: EL0060_AO_033015WM

Assuming the ladder diagram of figure "A" and the corresponding input/output diagram of figure "B" represents a simple PLC motor controller, what statement is true? Illustration EL-0232
The input switch is a maintained contact on-off selector switch, output "A" is the motor contactor coil, and output "B" is a motor run status lamp for the running condition.

Illustrations: EL0232_AO_052615WM

As shown in the illustration, by what means are all the 'MS' contacts are opened and closed? Illustration EL-0073
manual operation of the master switches

Illustrations: EL0073_WM_100518

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manual operation of the master switches

Illustrations: EL0073_WM_100518

If a digital multimeter is set up as shown in figure "A" of the illustration to test an AC contactor coil, what would the display read if the coil is open-circuited? Illustration EL-0214
OL ohms

Illustrations: EL0214_WM_101118
See REF1805

If a digital multimeter is set up as shown in figure "A" of the illustration to test an AC contactor coil, what would the display read if the coil is open-circuited? Illustration EL-0214
OL ohms

Illustrations: EL0214_WM_101118
See REF1805

As shown in figure "A" of the illustration, if in troubleshooting the control circuit using on-line techniques with a voltmeter with the start button depressed and the following readings are taken, what is the problem? "X1" to "X2" reads 115 VAC; "1" to "X2" reads 0 VAC; "2" to "X2" reads 0 VAC; and "3" to "X2" reads 0 VAC. Illustration EL-0123
the fuse is blown

Illustrations: EL0123_WM_100918

As shown in figure "A" of the illustration, if in troubleshooting the control circuit using on-line techniques with a voltmeter with the start button depressed and the following readings are taken, what is the problem? "X1" to "X2" reads 115 VAC; "1" to "X2" reads 115 VAC; "2" to "X2" reads 0 VAC; and "3" to "X2" reads 0 VAC. Illustration EL-0123
the stop button is open-circuited

Illustrations: EL0123_WM_100918

A 480/120 VAC step down control transformer as configured in figure "E" of the illustration produces 89 VAC across its secondary winding (across X1 and X2) with 480 VAC applied to the primary winding (across H1 and H2). What condition is indicated? Illustration El-0123
A few shorted turns in the secondary winding

Illustrations: EL0123_WM_100918

As shown in the illustration, what mechanism will disconnect the motor from the line in case of a sustained motor overload? Illustration EL-0080
overload relay heaters and overload relay NC contacts (OL)

Illustrations: EL0080_WM_100518

Which of the following contactors or relays has a timing function for the transition from start to run? Illustration EL-0080
KA1

Illustrations: EL0080_WM_100518

Which device will stop the motor shown in the illustration in case of a short-circuit (high current) motor fault? Illustration EL-0080
disconnect switch fuses FU1, FU2, and FU3

Illustrations: EL0080_WM_100518

As shown in the illustration of an electrically operated watertight door controller, how is reversal of the direction of motor rotation achieved? Illustration EL-0115
The armature windings are reversed.

Illustrations: EL0115_WM_100918

As shown in the illustration of an electrically operated watertight door controller, how is the motor stopped automatically when the door is wedged closed? Illustration EL-0115
Action of door closed limit switch (LSC).

Illustrations: EL0115_WM_100918

As shown in the illustration of an electrically operated watertight door controller, how is the motor stopped automatically when the door is wedged open? Illustration EL-0115
Action of door open limit switch (LSO).

Illustrations: EL0115_WM_100918

As shown in the illustrated electrically operated watertight door controller, how is the rotation direction of the door motor reversed? Illustration EL-0115
reversing the direct current direction through the motor armature and maintaining the same direct current direction through the motor series field

Illustrations: EL0115_WM_100918

As shown in the illustration of an electrically operated watertight door controller, what type of motor is used to open and close the watertight door? Illustration EL-0115
Series wound DC motor

Illustrations: EL0115_WM_100918

As shown in the illustration, what type of starter is illustrated? Illustration EL-0104
reduced voltage primary resistance starter

Illustrations: EL0104_WM_100918

As shown in the illustration, what is the purpose of the Time Delay (TR) coil in the circuit? Illustration EL-0104
Allows the motor to come up to speed at reduced voltage before bypassing the starting resistors.

Illustrations: EL0104_WM_100918

If the motor shown in the illustration will not start when the "off-run" switch is placed in the run position, which of the listed components should be checked FIRST? Illustration EL-0017
check the overload relay for tripped condition, reset as necessary

Illustrations: EL0017_WM_070819

If the motor shown in the illustration will not start when the "off-run" switch is placed in the run position, which of the listed components should be checked FIRST? Illustration EL-0017
check the overload relay for tripped condition, reset as necessary

Illustrations: EL0017_WM_070819

In the illustrated motor controller, what do the contacts across terminals "3" and "4" of the control circuit represent? Illustration EL-0017
normally-closed overload relay contact

Illustrations: EL0017_WM_070819

In the illustrated motor controller, what do the contacts across terminals "3" and "4" of the control circuit represent? Illustration EL-0017
normally-closed overload relay contact

Illustrations: EL0017_WM_070819

As shown in the illustration, which of the following conditions will occur as a result of a momentary loss of power? Illustration EL-0017
The motor will automatically restart when power is restored.

Illustrations: EL0017_WM_070819

As shown in the illustration, assuming power is available at the control circuit, which listed action will occur FIRST when the "off-run" switch is placed in the "run" position? Illustration EL-0017
The contactor coil "M" energizes.

Illustrations: EL0017_WM_070819

When a motor is started by the controller shown in figure "C" of the illustration, what circuit components are in the holding current flow path through the control circuit while the motor is in operation? Illustration EL-0010
the stop button contacts, the "B1" contacts, the "M" contacts, the "M" coil and the "OL" contacts

Illustrations: EL0010_AO_022515WM

In the illustration shown, what type of protection is provided the potable pump drive motor? Illustration EL-0043
thermal overload protection and low voltage release

Illustrations: EL0043_AO_030915WM

As shown in figure "A" and "B" of the illustration, the potable water pump is short cycling by the action of the pressure switch as a result of an unusually high level in the potable water hydro pneumatic header tank. What is most likely the cause? Illustration EL-0043
The potable water hydro-pneumatic header tank is in need of recharging with compressed air due to absorption of air into the water over time.

Illustrations: EL0043_AO_030915WM

Which of the following statements is true concerning the motor controller circuit shown in the illustration? Illustration EL-0004
The controller is configured for use with a three phase non-reversible squirrel-cage induction motor.

Illustrations: EL0004_AO_062617WM

Concerning the illustrated motor controller circuit, where is the location of the motor "run" indicator light? Illustration EL-0004
At the remote control station.

Illustrations: EL0004_AO_062617WM

Which of the following statements is true concerning the motor controller circuit shown in the illustration? Illustration EL-0004
The controller is configured for across-the-line (direct-on-line) starting.

Illustrations: EL0004_AO_062617WM

Which of the following illustrated manual motor starters represents the wiring diagram illustrated in figure "A"? Illustration EL-0023
1

Illustrations: EL0023_AO_091817WM

Which of the following illustrated manual motor starters represents the wiring diagram illustrated in figure "A"? Illustration EL-0023
1

Illustrations: EL0023_AO_091817WM

In referring to the illustration of the Ward-Leonard drive system, what type of DC generator is used? Illustration EL-0153
Separately excited generator.

Illustrations: EL0153_AO_042715WM

As shown in figure "B" of the illustration, when the DC motor in figure "A" is operating at base speed what are the armature and field characteristics? Illustration EL-0153
The motor is operating at maximum armature voltage and maximum field current.

Illustrations: EL0153_AO_042715WM

As shown in figure "B" of the illustration, when the DC motor in figure "A" is operating at minimum speed what are the armature and field characteristics? Illustration EL-0153
The motor is operating at minimum armature voltage and maximum field current.

Illustrations: EL0153_AO_042715WM

As shown in figure "A" of the illustration, what phenomenon is illustrated with respect to electrical cables and ground? Illustration EL-0126
distributive capacitance

Illustrations: EL0126_WM_100918

Using the temperature correction factor for the winding insulation temperature graph shown in the illustration, what would be the correction factor and the corrected temperature to 40 degrees C for a motor with a insulation resistance of 4 megohms measured at 50 degrees C? Illustration EL-0046
The temperature correction factor is 2 and the corrected resistance is 8 megohms at 40 degrees C.

Illustrations: EL0046_WM_100518

When using the test set-up shown in figure "A" of the illustration, besides the motor windings and the motor feeder cable, what circuit components are actually being meggered? Illustration EL-0027
the power circuit of the starter up to the load side of the main contacts

Illustrations: EL0027_AO_030915WM

Suppose it is desired to connect a dual voltage three-phase squirrel-cage induction motor for low volts, but it is undetermined whether the nine-lead motor is internally configured for wye or delta configuration. Using an ohmmeter, the motor itself with leads disconnected, and the illustration as a guide, what statement is true? Illustration EL-0134
If leads "7", "8", and "9" have continuity across each other, the motor is "wye" configured. Without continuity, the motor is "delta" configured.

Illustrations: EL0134_AO_031918WM

When re-greasing the electric motor bearing as shown in figure "B" of the illustration, what practice should be avoided? Illustration EL-0218
Completely filling the bearing cavity with new grease.

Illustrations: EL0218_WM_101118

As shown in figure "D" of the digital power meter shown in the illustration, what type of single phase load is under test for power measurement? Illustration EL-0256
an inductive-resistive load

Illustrations: EL0256_WM_030519
See REF1805

As shown in figures "B" and "C" of the illustration, what should be the switch position and which test lead terminal jacks should be used if your intent is to measure DC currents anticipated as high as 200 milliamps? Illustration EL-0047
switch position "6" and terminal jacks "1 and 4"

Illustrations: EL0047_WM_100518

As shown in figure "A" of the illustrated digital multimeter screen, what would be the significance of the symbol indicated by "2" being illuminated? Illustration EL-0047
the selector switch is in the continuity/diode test position and the secondary function pushbutton is toggled for diode

Illustrations: EL0047_WM_100518

As shown in figure "A" of the digital multimeter screen shown in the illustration, what would be the significance of the symbol indicated by "1" being illuminated? Illustration EL-0047 "
the selector switch is selected for continuity/diode test and the secondary function pushbutton is toggled for continuity

Illustrations: EL0047_WM_100518

What is the circuit shown in the illustration used to measure? Illustration EL-0024
resistance

Illustrations: EL0024_AO_060116WM

Using the portable harmonic analyzer shown in figure "A", if the clamp-on test lead is connected as shown in figure "C" of the illustration, what is being measured? Illustration EL-0110
the harmonic content of the current of a single conductor at a service entrance

Illustrations: EL0110_AO_041315WM

As shown in all four diagrams included in the illustration, what type of logic circuit is represented? Illustration EL-0234
NOR gate

Illustrations: EL0234_AO_061318WM

As shown in all four diagrams included in the illustration, what type of logic circuit is represented? Illustration EL-0233
NAND gate

Illustrations: EL0233_WM_101118

As shown in figure "C" of the illustration, what type of timer is represented? Illustration EL-0242
on-delay timer

Illustrations: EL0242_AO_061818

As shown in all four diagrams included in the illustration, what type of logic circuit is represented? Illustration EL-0227
OR gate

Illustrations: EL0227_WM_020620

As shown in figure "A" of the illustration, what input conditions are required to produce an output? Illustration EL-0241
Either "Input 1" or "Input 2" must be closed OR both "Input 3" and "Input 4" must be closed.

Illustrations: EL0241_AO_060215WM

As shown in all four diagrams included in the illustration, what type of logic circuit is represented? Illustration EL-0226
AND gate

Illustrations: EL0226_WM_020620

As shown in figure "A" of the illustrated PLC sub-circuit, what type of circuit is depicted? Illustration EL-0230
DC input unit

Illustrations: EL0230_AO_052615WM

As shown in the illustrated block diagram for a programmable logic controller system, in what functional component is the program developed and used to transfer the program to the memory unit of the PLC? Illustration EL-0225
programming device

Illustrations: EL0225_AO_052615WM

In referring to figure "A" of the illustration, what type of active filter circuit is shown? Illustration EL-0077
Low-pass filter circuit

Illustrations: EL0077_AO_100518WM

What is the name for the device shown in figure "A" of the illustration? Illustration EL-0064
half wave rectifier

Illustrations: EL0064_WM_060216

As shown in the illustrated harmonic analysis diagram, which figure represents the fundamental (or first harmonic)? Illustration EL-0163
B

Illustrations: EL0163_AO_041818WM

A carbon resistor has a resistance of 50 ohms, and a tolerance of 5 percent. What would be the respective colors indicated for bands 1, 2, 3 and 4 for this resistor as shown in figure "A" of the illustration? Illustration EL-0103
green, black, black, and gold.

Illustrations: EL0103_WM_100918
See REF1894

As shown in figure "A" of the illustration, under what conditions will the thyristor conduct? Illustration EL-0154
when the anode is more positive than the cathode and when the gate is briefly pulsed with a voltage more positive than the cathode

Illustrations: EL0154_AO_042715WM

As shown in figure "A" of the illustration, what is true concerning the illustrated frequency response curve? Illustration EL-0076
Low frequencies below the cutoff-frequency are attenuated and high frequencies above the cut-off frequency are passed.

Illustrations: EL0076_WM_100518

In referring to the graphs shown in the illustration, which of the following figures represents a band pass filter? Illustration EL-0076
C

Illustrations: EL0076_WM_100518

As shown in figures "A", "B", and "C" of the illustration, what is the purpose of the differential amplifier segment of the 741 operational amplifier? Illustration EL-0111
detect and amplify the voltage difference between the inputs at pins 2 and 3

Illustrations: EL0111_WM_100918

As shown in the illustrated block diagram for a distributed automation system, what statement is true concerning the area networks? Illustration EL-0096
The LAN is a dual redundant network and the partitioned CAN is also a dual redundant network, with both networks being interconnected.

Illustrations: EL0096_WM_100918

As shown in the illustrated block diagram for a distributed automation system, what statement is true concerning the workstations labeled "LOS" associated with the port power management system? Illustration EL-0096
These are local operating system workstations that allow local control of processes related to the operation and control of the port generator.

Illustrations: EL0096_WM_100918

As shown in the illustrated block diagram for a distributed automation system, what statement is true concerning the units labeled "ROS" which are remote operating system workstations? Illustration EL-0096
Operator access to control functions among the various ROS locations differ depending system configuration and need.

Illustrations: EL0096_WM_100918

As shown in figure "B" of the illustrated block diagram of the signal processing flow path, what does the block "TRANSDUCER" represent? Illustration EL-0095
These are sensing and transmitting devices designed to sense and measure a physical parameter and convert it to a proportional analog electrical signal.

Illustrations: EL0095_WM_100918

As shown in figure "A" of the illustration, what is the configuration of the operational amplifier? Illustration EL-0252
inverting amplifier

Illustrations: EL0252_AO_060215WM

Referring to figure "3" of the illustration, what type of logic gate is symbolized? Illustration EL-0035
AND gate

Illustrations: EL0035_WM_100518

Referring to figure "4" of the illustration, what type of logic gate is symbolized? Illustration EL-0035
NAND gate

Illustrations: EL0035_WM_100518

Referring to figure "5" of the illustration, what type of logic gate is symbolized? Illustration EL-0035
XOR gate

Illustrations: EL0035_WM_100518

What is the name of the digital logic gate represented by figure "1" of the illustration? Illustration EL-0035
OR gate

Illustrations: EL0035_WM_100518

Referring to figure "1" of the illustration, what type of logic gate is symbolized? Illustration EL-0035
OR gate

Illustrations: EL0035_WM_100518

Referring to figure "2" of the illustration, what type of logic gate is symbolized? Illustration EL-0035
NOR gate

Illustrations: EL0035_WM_100518

If the clock frequency input to the circuit shown in the illustration were 2 kHz, what would be indicated at the output of 'FF-3' at the Q3 output? Illustration EL-0087
125 Hz

Illustrations: EL0087_WM_100518
See REF1808

As shown in figure "B" of the illustrated function block for a PLC PID controller, to what input is the actual analog signal of the measured value delivered? Illustration EL-0251
PV

Illustrations: EL0251_WM_101118

As shown in figure "A" of the illustration, what type of converter unit is represented? Illustration EL-0240
analog to digital converter

Illustrations: EL0240_WM_101118

In figure "A" of the illustrated circuit, the amplifier is connected in what basic configuration? Illustration EL-0045
common emitter

Illustrations: EL0045_WM_100518

As shown in figure "C" of the illustration, what are the purposes of the coupling capacitor Cc and the bypass capacitor Cbp respectively _____. Illustration EL-0045
Cc blocks any DC component associated with the input from reaching the base Cbp helps minimize degeneration of the AC output signal

Illustrations: EL0045_WM_100518

In figure "A" of the illustration, the battery Vbb and resistor Rb are in the circuit for what purpose? Illustration EL-0022
to apply a forward bias to the emitter-base

Illustrations: EL0022_AO_022515WM

The transistors in figure "B" the illustrated circuit are connected using what type of coupling? Illustration EL-0048
RC coupling

Illustrations: EL0048_AO_091411WM

What controls rudder movement when the Operation Selector Switch shown in figure "A" of the illustration is in the "Controller" position? Illustration EL-0097
non-follow-up controller

Illustrations: EL0097_AO_041315WM

As shown in figure "A" of the illustration, fine adjustments such as "rate of turn signal" have no effect on steering stand operation when the 'operation selector switch' is in what position? Illustration EL-0097
NFU

Illustrations: EL0097_AO_041315WM

As shown in figure "A" of the illustration, the actual rudder angle repeatback signal originates at what device and is delivered to what other device? Illustration EL-0097
originates at the power unit and delivered to the amplifier

Illustrations: EL0097_AO_041315WM

If coil 'R1-R2-R3' on the transmitter in figure "C" shown in the illustration is turned 30 degrees clockwise, how will the corresponding coils 'R1-R2-R3' on the receivers (indicators) respond? Illustration EL-0092
torque will cause them to align to the same position

Illustrations: EL0092_WM_100518

In actual applications, electrical connections associated with 'R1, R2 and R3' of the transmitter to 'R1, R2, and R3' of the indicators shown in figure "C" of the illustration are made by what means? Illustration EL-0092
slip rings and brushes

Illustrations: EL0092_WM_100518

What is the name of the mechanism used to transmit rudder angle information from the steering gear itself to the wheelhouse in the illustrated rudder angle indicator system? Illustration EL-0092
synchronous transmission

Illustrations: EL0092_WM_100518

What does figure "C" of the illustration represent? Illustration EL-0092
a synchronous transmission system with a single transmitter and two receivers each equipped with a single phase stator winding and a three phase rotor winding

Illustrations: EL0092_WM_100518

Erratic operation of the device represented in the diagram labeled "A" shown in the illustration could be traced to what condition? Illustration EL-0092
improper contact at "R" slip rings or "S" connections

Illustrations: EL0092_WM_100518

If coil 'R1-R2-R3' on the transmitter in figure "C" shown in the illustration is turned 30 degrees clockwise, how will the corresponding coils 'R1-R2-R3' on the receivers (indicators) respond? Illustration EL-0092
torque will cause them to align to the same position

Illustrations: EL0092_WM_100518

If it is required that the coils 'R1-R2-R3' in the indicator of figure "A", turn opposite to those in the transmitter, as shown in the illustration, what action should be taken? Illustration EL-0092
Interchange leads 'R1' and 'R3'.

Illustrations: EL0092_WM_100518

In actual applications, electrical connections associated with 'R1, R2 and R3' of the transmitter to 'R1, R2, and R3' of the indicators shown in figure "C" of the illustration are made by what means? Illustration EL-0092
slip rings and brushes

Illustrations: EL0092_WM_100518

What is the name of the mechanism used to transmit torque angle over distance in the illustrated rudder angle indicator system? Illustration EL-0092
synchronous transmission

Illustrations: EL0092_WM_100518

What type of motor is used in the AC hoist controller as shown in the illustration? Illustration EL-0102
wound rotor induction motor

Illustrations: EL0102_WM_061319

What statement is true concerning the 'MS 1' contacts of the master switch shown in the illustration? Illustration EL-0102
They are closed only when the master switch is 'off'.

Illustrations: EL0102_WM_061319

What is the functional purpose of the 'LSL' contacts for the hoist controller circuit shown in the illustration? Illustration EL-0102
It is a limit switch which automatically stops the winch drum rotation in the lower direction before all the cable is payed out insuring that a few wraps remain on the drum

Illustrations: EL0102_WM_061319

What is the functional purpose of the 'MS 2' contacts in the hoist controller circuit shown in the illustration? Illustration EL-0102
The 'MS 2' contacts are not used in this particular application

Illustrations: EL0102_WM_061319

As shown in the illustration, how are the rotor windings of the motor configured? Illustration EL-0102
wye

Illustrations: EL0102_WM_061319

Which of the listed conditions occur when selection is made for 'third point hoist' on the winch hoist controller shown in the illustration? Illustration EL-0102
Master switch contacts "4","5", and "6" close.

Illustrations: EL0102_WM_061319

As shown in the illustration, what is responsible for maintaining the "UV" relay energized when the master switch handle is moved away from the "off" position? Illustration EL-0102
normally open 'UV' contacts

Illustrations: EL0102_WM_061319

An AC winch hoist controller such as shown in the illustration has welded contacts on the hoist contactor, and the contacts must be replaced. Before replacing the contacts, the cause for the welding of the contacts must be determined. What statement represents possible causes? (EL0102)
The welding of contacts may be caused by low applied voltage to the operating coil (less than 85% of rated voltage) or by weak springs.

Illustrations: EL0102_WM_061319

What functionality do the 'MS 1' contacts of the master switch shown in the illustration provide? Illustration EL-0102
low voltage protection

Illustrations: EL0102_WM_061319

An AC winch hoist controller such as shown in the illustration has a burned out hoist contactor coil, and the coil must be replaced. Before replacing the coil, the cause for the burn-out must be determined. What statement represents possible causes? Illustration EL-0102
The coil burnout may occur with a normal voltage applied to the coil (between 85% and 110% of rated voltage) if accumulated dirt prevents proper seating of the armature to the magnet.

Illustrations: EL0102_WM_061319

What is the functional purpose of the 'LSH' contacts for the hoist controller circuit shown in the illustration? Illustration EL-0102
it is a limit switch which automatically stops the winch drum rotation in the hoist direction before the hoist block is able to strike the boom

Illustrations: EL0102_WM_061319

As shown in the illustration, what is the functional purpose of the normally closed and normally open auxiliary contacts of the hoist and lower contactors respectively? Illustration EL-0102
the normally closed hoist and lower contactor auxiliary contacts are interlock contacts preventing simultaneous pulling in both the hoist and lower contactors and the normally open contacts extend control power to the speed control circuits

Illustrations: EL0102_WM_061319

The progressive operation of the contactors marked "1A" through "4A" provide the winch hoist controller shown in the illustration with what functionality? Illustration EL-0102
acceleration

Illustrations: EL0102_WM_061319

The shunt makes it possible to measure much larger currents flowing in a circuit than could be done if that current were routed through the tiny wire in the meter's coil. This effectively extends the range and usefulness of the meter.

REF1950
The high resistance restricts the flow of current through the meter coil.

REF1951
When the hand-cranked generator on the megger is not being operated, the pointer floats freely and may come to rest at any position on the scale. The megger needle at zero indicates a ground. Unless the megger is grounded, its needle will float at some other position.

REF1952
Across-the-line starting applies the full voltage available to start an electric motor. Autotransformers and resistors are used to start motors when it is necessary to regulate the inrush of electric current to either prevent damage to the motor or to protect the system that furnishes the electric power.

REF1953
When the relay senses an overcurrent in its operating coil, which is connected in series with an electric motor, it causes the contacts to open. The open contacts deenergize the motor controller. "Instantaneous" can mean as little as 0.02 seconds to clear afault.

REF1954
46 CFR 111,

REF1955
The motor will slow but continue to run. However, it will also begin to heat up. The thermal overload relay will sense this overheating and trip the controller. If a three-phase motor stops, it will not restart with an open in one phase and will heat very rapidly.

REF1956
The preferred way to clean dust and foreign matter from electrical equipment is by vacuum suction.

REF1957
Low voltage causes a weak magnetic pull so that the contacts do not close tightly. It also causes a relatively high resistance between the stationary and the moving contact surfaces. If this resistance is greater than in the rest of the circuit, the heat generated at the contact surfaces may cause the contacts to weld together.

REF1958
Accidentally-welded contacts may prevent a relay from dropping out (i.e., opening) when it loses coil voltage.

REF1959
Chattering or humming in a circuit breaker, relay or controller may be caused by low operating coil voltage or dirt on the faces of the magnet. Dirty magnet faces prevent the magnetized coil, which is an electromagnet, from holding the contacts firmly closed.

REF1960
If a few turns become short circuited, the coil may weaken and may become unreliable.

REF1961
If the brushes are too hard, they may wear down the surface of the commutator. Always use the brushes specified by the manufacturer.

REF1962
A properly operating DC motor's commutator be chocolate brown in color.

REF1963
The stop button breaks the circuit to the electromagnets that hold the contacts together. If magnetic force is no longer holding the contacts together, there must be some other physical connection holding them closed. This means the

contacts are probably welded together.

REF1964
If you place a load on an operating motor, its rotor will slow down and its slip will increase. The rotating field will induce higher currents in the rotor. This will provide the increased torque that allows the motor to handle the load. However, if the motor is overloaded, it will slow down and stall.

REF1965
AC motor name plates contain information on the temperature rise the motor is designed for. Preserve the information on the name plate, you may have to call an electrician to simply identify a piece of equipment so that you can order a replacement.

REF1966
Universal motors operate on both AC and DC. They have brushes and commutators. They are used to power portable tools, small fans and other fractional horsepower applications.

REF1967
The starting winding on a split-phase induction motor is not designed to carry current when the motor is running. If the cutout switch for this winding does not operate (i.e., fails to open,) the winding will probably burn out. To change the direction of rotation of a three-phase induction motor, switch any two of the phase leads to the stator. An induction motor that operates at a fixed frequency can provide several different speeds only if you reconnect the stator windings (i.e., field windings) to provide a different number of poles.

REF1968
A squirrel-cage rotor consists of a laminated iron core that is slotted lengthwise all around its periphery. Solid bars of aluminum, copper, or other conductors are tightly pressed or embedded in its slots. At both ends of the rotor, short-Circuiting rings are welded or brazed to the bars to make a solid structure which, if removed as a unit, would resemble a squirrel cage. The squirrel-cage rotor in an AC motor is very simple in construction when compared to a DC motor's armature with its complicated windings.

REF1969
What is the main function in the use of a capacitor for starting a single phase motor? Note: A capacitor-start motor and resistor-start motor are two types of single phase ac induction motors. The capacitor-start type motor develops a very high starting torque, and is used for loads which are hard to start. The resistor-start type motor develops a considerably smaller torque and is used for moderate starting loads, or where the load is applied after the motor has obtained its operating speed. A. Reduce radio interference Incorrect answer. Motors generate electrical “noise” which can interfere with radio reception. A ceramic capacitor properly connected to the motor can reduce the chance of this type of interference. This type of capacitor provides no function in the starting of the motor. B. Split the phase to establish a rotating magnetic field Correct answer. Induction motor action requires a rotating magnetic field. To obtain a rotating magnetic field from a single-phase system, the motor current is split into two separate windings. The capacitor-start motor uses a capacitor in series with an auxiliary (starting) winding which causes the current in the auxiliary winding to lead the current in the main winding. Consequently, the magnetic field in the auxiliary winding will reach its maximum value before that of the magnetic field in the main winding resulting in rotation of the motor rotor. The capacitor and auxiliary winding are disconnected from the circuit by an automatic switch when the motor reaches approximately 75% of its rated full load speed. C. Reduce the phase angle Incorrect answer. A capacitor inserted in series with the starting winding increases the phase angle (shift) resulting in a starting torque that is greater than that developed by the resistor-start motor. D. Prolong the life of the starting contacts Incorrect answer. Periodic checks and adjustment for any wear or misalignment, as well as the removal of dirt and grease from the contact faces will help prolong the life of contacts, not the use of a capacitor. Capacitor motors. This type of motor also operates only on single-phase AC. It is similar to the split-phase type, with the addition of a capacitor or a condenser that enables it to start much heavier loads. There are several grades of capacitor-type motors available, ranging from the home-workshop type that starts loads from 1 1/2 to 2 times as heavy as the split-phase, to the heavy-duty type that will start almost any type of load. Capacitor motors usually are more efficient than split-phase motors, using less power (watts) per horsepower. The amperage (I) consumed while starting is usually less than half that of the split-phase type. Capacitor motors are commonly used only in sizes up to 10 hp . Capacitor-type motors are frequently used in small portable pumps of low horsepower.

REF1970

You can change the speed of a synchronous motor by changing the frequency of the current to the stator and/or the number of poles in the stator. To reverse a turbo-electric, synchronous motor propulsion unit, change the phase sequence of power to the motor. To change the speed of such a unit, change the speed of the turbine itself. The input power from commercial sources is generally a constant 60 Hz and seldom varies.

REF1971
Sandpaper is a non-conductor of electricity. Emery cloth contains particles that could become embedded in the brushes, cause sparking, and grind and damage the surface of the commutator. The grit side of the sandpaper must face the brushes. The smooth side should follow the curvature of the commutator.

REF1972
The starting winding on a split-phase induction motor is not designed to carry current when the motor is running. If the cutout switch for this winding does not operate (i.e., fails to open,) the winding will probably burn out. If the starting winding remains connected, the motor will draw excessive current from the line. The starting winding may overheat and be damaged. If this happens and the Winding burns out, the motor will not be able to start itself because it will no longer be able to split the single-phase current.

REF1973
To test for an open circuit, you must test each winding separately

REF1974
An "open " coil would provide infinite resistance. Infinite resistance is marked on the face of the meter with the symbol of "infinity."

REF1975
A growler is an instrument that is powered by AC power (i e., plugged into a wall socket) and pulled across the coils in the stator of an AC motor. If it "growls, " the coil is shorted.

REF1976
Note: The data nameplate on an induction motor lists the rated horsepower, which is the power it is capable of developing without overheating. In addition, the rated RPM and the rated amperage values are listed on the nameplate. The rated values of RPM and amperage are the values associated with the induction motor when developing the rated horsepower. Although torque is not generally listed on a motor’s data nameplate, rated torque is torque that is produced when the motor is developing its rated horsepower. When an induction motor is developing less than its rated horsepower, the RPM will be higher than the rated RPM (but less than the synchronous RPM), the amperage draw will be lower than its rated current, and the torque will be less than its rated torque. Similarly, when an induction motor is developing more than its rated horsepower, the RPM will be lower than the rated RPM, the amperage draw will be higher than its rated current, and the torque will be higher than its rated torque. A. power required to drive the load Correct answer. See the explanation in the note above. B. speed required to drive the load Incorrect answer. Although speed does change with changes in load (the greater the load, the greater the slip), the motor adjusts itself to produce exactly the amount of power required to drive the load. C. current flow in the motor stator Incorrect answer. Although current draw does change with changes in load (the greater the load, the greater the slip, the greater the current draw), the motor adjusts itself to produce exactly the amount of power required to drive the load. D. torque developed by the rotating field Incorrect answer. Although developed torque does change with changes in load (the greater the load, the greater the slip, the greater the current draw, the greater the torque), the motor adjusts itself to produce exactly the amount of power required to drive the load.

REF1977
Under ideal conditions, a synchronous motor will run at the speed of the alternator that supplies its power. The presence of six poles instead of four poles means that there will be additional north/south pole attractions for each complete revolution of the motor. The net result will be more contacts yet fewer complete revolutions of the rotor per minute (rpm).

REF1978
In a three phase, squirrel-cage type induction motor, the rotating magnetic field is established by the _____. A. current induced in the rotor windings Incorrect: The rotor of an induction type motor does not induce a magnetic field in the stator. AC voltages are induced in the rotor circuit as the result of the rotating magnetic field in the stator. B. application of a three phase voltage supply to the stator windings Correct: The principle of a rotating magnetic field is the key to the operation of most AC induction motors. The sequential AC phase angle relationships are used to alternately magnetize adjacent stator coils. The sequential shift in magnetization between adjacent stationary stator coils creates the effect and

appearance of a rotating magnetic field. The apparent shifting of the magnetic field in the stator induces an internal rotor current creating a second interacting magnetic field in the rotor producing shaft torque. C. laminated steel core and aluminum conductors in the rotor Incorrect: A laminated steel core is used in place of a solid iron core for the construction of the rotor to minimize the effect of "eddy" currents. Small stray electrical currents generated within the core material of the rotor by the induced magnetic field results in the buildup of heat. The resultant electrical energy loss or "eddy current loss" and can be reduced by increasing the resistance of the eddy current path by a production process achieved through laminating the core. D. interaction of the magnetic field caused by the induced current in the squirrel-cage bars with the magnetic field of the stator. Incorrect: The interaction of the generated magnetic fields between the stator and rotor causes the motor shaft to rotate as a result of applying AC current to the stator windings and the resultant induced magnetic field interaction with the squirrel cage rotor. In an induction motor the rotating field is established in the stator rather than the rotor.

REF1979
Wound-rotor AC motors have the ability to start extremely heavy loads. They can drive equipment that requires considerable starting torque to overcome friction. They can accelerate very heavy loads with flywheels or loads that possess considerable inertia. This type of motor also has the power to overcome backpressure set up by fluids and gases in reciprocating pumps and compressors. Wound-rotor AC induction motors use slip rings and brushes to transfer the current from the rotor to brushes on the stator. One of the advantages of using a wound rotor (i e., with wire windings wound on the rotor) is that current in the wire from the windings can be brought out of the rotor through slip rings. This means that the resistance, and therefore the current, passing through the rotor can be controlled. A rheostat is a variable resistor and is the device used to control the resistance and, therefore, the speed of the motor. Slip rings and the wound rotor make this AC motor resemble a DC motor. It also makes the motor more complex and more expensive. However, in some AC applications where speed control is important, this motor can meet the output requirements of certain special applications. However, most of these applications require a supply of three-phase power. Note: Another name for a slip ring induction motor is a wound rotor induction motor. Discrete multispeed operation of a wound rotor motor can hypothetically be achieved by changing the number of poles, which at constant frequency changes the speed of rotation of the rotating magnetic field associated with the stator. Discrete multispeed operation can also be achieved by inserting discrete amounts of resistance into the wound rotor circuit, which changes the torque-speed characteristics of the motor.

REF1980
Sand paper

REF1981
To change the direction of rotation of a DC motor you should either: 1. Reverse the polarity of the field poles or; 2. Reverse the current to the brushes. However, if you reverse both the polarity and the current, the motor rotation will remain the same.

REF1982
Product = the result of multiplying two numerical quantities. Torque is measured in foot-pounds, a derivative unit that means distance in feet multiplied by force measured in pounds.

REF1983
46 CFR, Subchapter J

REF1984
46 CFR 111.60-11(e)

REF1985
One maximum current peak is a positive (+) voltage while the other is a negative (-) voltage.

REF1986
Series circuits have all components connected so electricity flows in a straight line through all components. In batteries this means the positive (+) pole of one battery is connected to the negative (-) pole of the net battery. In series circuits the voltages and resistances are added while the same current flows through all components.

REF1987
Transpose the formula Ps = Es Is , to find the current drawn from the secondary (Is). Is = Ps/Es . Since you only know the voltage across the primary winding (440 volts) and the ratio of the number of turns is a step-down transformer of 4 to 1,

you must use the formula: Es = Ep (Ns/Np) Es = 440 volts (1/4) Es = 110 volts. Going back to the original formula Is = Ps/Es , you can substitute the new value of Es . Is = 2,000 (2KVA) volt amps/110 volts. Is = 18.18 amps. A transformer is an electrical device that is used in alternating current (AC circuits to either step-up (i.e., increase) or step down (i.e., decrease) the voltage within that circuit. In doing so, the electrical energy is always changed or transferred from winding to winding inside the transformer without a change of frequency (Le., Hertz or cycles). In other words, if 60-Hertz power enters a transformer, 60-Hertz power will leave it! However, a transformer will change both the voltage (E) and the current (I) by a predetermined amount. Transformers require little care and maintenance because of their simple and rugged construction. A transformer's efficiency is very high. There is generally little energy waste that appears in the form of heat. In part as a result of this fact, transformers are responsible for the more widespread use of alternating current (AC) than direct current (DC) throughout the world. A transformer has no moving parts and is, therefore, a very dull and uninspiring piece of equipment. It is usually protected by a suitable enclosure and left alone until such time as it bums out and becomes noticeable by the stench of its burning insulation. The typical transformer has two windings, called a primary and a secondary winding, that are insulated electrically from each other. In other words, there should be no direct contact between the electricity in one winding and the electricity in the other winding. In fact, direct contact must be avoided! When a transformer is used to step up the voltage, the low voltage winding is called the primary. Conversely, when a transformer is used to step down the voltage, the high-voltage winding is called the primary. The primary is always connected to the source of the power while the secondary is always connected to the load. It is common practice to refer to the windings as the primary and secondary rather than the high voltage and low voltage windings. The principal types of transformer construction are the core type and the shell type. The cores are built of thin stampings (ie., sheets or laminations) of silicon steel. Eddy currents, generated in the core by the alternating flow of current as it cuts through the iron, are minimized by using thin laminations and by insulating adjacent laminations with insulating varnish. All transformer windings must be treated to resist moisture, sea atmosphere, and oil vapors . The permissible temperature rise is limited by the type of insulation used in the transformer windings. A heat build up in transformer windings will breakdown or melt the insulation and lead to short circuits and fire. Step down transformers reduce 120-volt AC line voltage to 12-volt AC or 32-volt AC voltage. When replacing a transformer, re-connect the polarity marks the same way as before to ensure that the equipment runs as it did before (i.e. , that the motors rotate properly, etc.) Transformers are classed according to how they change the voltage. If the voltage on a transformer's secondary windings is higher than on its primary windings, it is called a "step-up transformer". If the secondary voltage is lower than the primary voltage, it is a "step-down transformer". You can determine the ratio of change in voltage by comparing the number of turns on the transformer's primary windings to the number of turns on the secondary. The change in current is inversely related to this ratio of turns . For example, if the secondary voltage is tripled (i.e. , multiplied 3 times), the secondary amperage will be reduced to one-third the amperage of the primary. A study of basic electrical theory starts with a study of magnets and magnetism. A knowledge of how permanent magnets and electromagnets work is basic to an understanding of how transformers, electric motors and generators work.

REF1988
Repeated heating and cooling causes rubber insulation to harden and crack. You should investigate any strange smell suspected of being hot or burning insulation immediately to find the cause and prevent further damage.

REF1989
A full wave rectifier requires four diodes. If only one diode is defective (i.e., burned out or in an "open" condition), then a rectified half wave will be produced. A rectifier changes alternating current into direct current. In doing so it only allows the alternating current to flow in one direction and not the other by using only one-half of the alternating current 's sine wave.

REF308
When paralleling generators and alternators, the machine coming on-line must have a slightly higher voltage so that it picks up some of the load when it is placed "on the by closing the circuit breaker. If machines are not "in phase" (i.e., synchronized) when they are paralleled, severe cross currents will occur and may cause damage. The maximum machines can be out of phase is 180°. Machines operating in parallel are both on line and sharing the load. However, they must have the same frequency, number of phases and phase rotation to do this. When paralleling, if the synchronizing lamps are dark and the synchroscope is at 12 o'clock (i.e., the 0° position), it indicates the oncoming alternator is "in phase" with the bus. To place an alternator "on line", adjust the oncoming machine's speed until the synchroscope revolves slowly in the "fast" direction. Then close the circuit breaker when the synchroscope is at the 12 o'clock (i.e., 0° position). The oncoming alternator should have slightly higher frequency than the "on-line" or bus frequency to: 1. Assume its load immediately, 2. Not "float" on the line, 3. Not "motorize" and activate the reverse power relay. After closing the circuit breaker to "parallel" the two machines, you should balance the loads (kilowatts) between the two machines by adjusting the governor settings.