Answers Electrical Motor Controls Chapter 11 and 16

1. What are the three parts of an industrial pushbutton? Legend plate, operator, and contact block(s)

2. What color legend plate is typically used for an emergency stop application? Red

3. What color legend plate is typically used for a reset function? Amber

4. What are some different types of pushbutton operators? Flush, half-shrouded, extended and mushroom

5. What is the main advantage of the half-shrouded pushbutton over the flush pushbutton? Can be easily operated with gloves on

6. What contacts are normally included on a pushbutton contact block? One NO and one NC

7. Which NEMA enclosure type is suitable for Class I locations? 7

8. What is the main difference between a pushbutton and a selector switch? Knob rotated instead of pushed to activate contacts.

9. What is one application of a two position selector switch? Hand-Controlled manually or Auto-controlled automatically by a temperature or pressure switch, left-right, up-down, slow-fast, jog-run, etc.

10. What does the three position selector switch typically add to the control? An off position

11. What is indicated by a truth table? Contact position in each switch position

12. What is indicated by an “X” in a truth table? Contacts closed

13. What is one advantage of using a joystick? Don’t have to take your eyes off the process

14. What is the term used to describe a mechanical switch that requires physical contact of the object with the switch actuator? Limit switch
15. What are some common applications of a limit switch? Light control in microwave or oven, washing machine lid switch, open door light in automobile

16. What is the advantage of a “snap-acting” switch? Reduce arcing

17. What is the result of not maintaining proper polarity between the NO and the NC contacts of a limit switch? Arcing or welding of contacts

18. Which part of a limit switch transfers the mechanical force of the moving part to the contacts? Actuator

19. When is a fork lever actuator typically used? Target object travels in two directions

20. Which actuator operates from direct force into the switch with limited travel? Push Roller

21. What movement of a wobble stick operator will cause it to operate? Anything but a direct pull

22. What are the four terms of travel for a limit switch? Pre-travel, Over-travel, Differential travel, and Release travel

23. What is the advantage of having a tapered cam to operate limit switch contacts? Prevent roller bounce and switch wear

24. What precaution must be taken with push-roller actuators more than the other types? Do not operate beyond their physical limit (distance of travel)

25. What are some applications for a foot switch? Sewing machine, lathe, drill press

26. What is the main operating principal of daylight switches? Sensor changes resistance with a change in light intensity. Higher light source means lower resistance so current flows and energizes the coil opening the NC contacts. As light decreases the resistance increases and the relay de-energizes closing the NC contacts to energize the light.
27. What is the term used to describe force exerted over a surface divided by the area? **Pressure**

28. What are three types of pressure that can activate a pressure switch? **Positive, negative, and differential**

29. What type of contact is typically used to maintain a pressure in a system? **NC**

30. What type of sensing device is typically used in high-pressure sensing applications? **Piston**

31. Which pressure sensing device has folds that expand and contract as pressure changes? **Bellows**

32. What is the term used to describe the amount of pressure that must be removed after a switch activates until it resets? **Deadband**

33. Where is deadband at its maximum value? **Top of the pressure scale**

34. What is the advantage of deadband? **Keeps contacts from chattering**

35. What is the main problem with a pressure switch that has a large deadband? **Can’t maintain pressure within a close range**

36. What type of switch would be used to sound an alarm if a sprinkler system activates? **Flow switch (NC)**

37. How is the switch adjusted for different rates of flow? **Spring tension**

38. What is the first indication of ice forming on the coils in a refrigeration unit? **Reduced air flow**

39. What is the result of insufficient air flow over heating elements in a duct system? **Element burn out**
40. What is the advantage of switching sensors on gas detectors? Detect different types of gasses

41. Which switch type is affected by turbulence, corrosiveness, density, and physical state? Level switch

42. What is one limitation of mechanical level switches? Materials that dry with a crust

43. What are some of the most common types of mechanical level switches? Toilet tank, sump pump, and bilge pump in a boat

44. What is one advantage of a magnetic level switch? Several individual switches may be placed on one housing

45. What characteristic must a liquid have if a conductive probe level switch is to be used? Must conduct electricity fair to well

46. How many probes are required for a Conductive probe level switch to detect a liquid at different heights if a non-conductive tank is used? 3

47. What is dielectric variation? The range at which a material can sustain an electric field with a minimum dissipation of power.

48. What is the best sensor to detect products such as plastic granules, shredded paper, toner and powders? Capacitive

49. What is the principle of the optical level switch? Refractive index of liquid compared to air

50. Which type of contact is typically used with a discharging tank system? NO

51. What is the main advantage of two-level control for a system? Allows longer time between cycles (pump starts and stops less frequently)

52. Skip to Page 325 (Preventing Problems When Installing Control Devices)
53. What type of loads are the most destructive to contacts when switched? **Inductive**

54. What is the result of the large induced voltage being present when switching inductive loads? **Arcing (contacts burn, stick or weld)**

55. What device is installed in a circuit to help protect the contacts when switching DC circuits? **Diode in parallel with load**

56. What device is installed in the circuit to help protect the contacts when switching AC circuits? **RC Snubber across the switch contacts**

57. How is a pressure switch protected from over pressure? **Relief valve**

58. What is the minimum distance for straight pipe on either side of a 2” flow switch? **6”**

59. What electronic device is typically used to switch AC circuits? **Triac**

60. What electronic device is typically used to switch high-power DC circuits? **SCR**

61. What device is used to test an electromechanical switch? **DMM set to voltage**

62. What device is used to test a solid-state switch? **DMM set to voltage**

63. What is the main advantage of smart input devices? **Reduce wiring and simplify troubleshooting (allows for printed documentation of system function)**

Chapter 16

1. What is the main advantage of photoelectric sensors over proximity and ultrasonic sensors? **Longer sensing distance**

2. What are the two main parts of a photoelectric sensor? **Light source (phototransmitter) and photosensor (photoreceiver)**
3. What are some factors that determine the best scanning technique? Scanning distance, size of target, reflectance of target, target position, color differences between target and background, changes in ambient light intensity, and condition of surrounding air (impurities)

4. Which scan technique works well in heavy dust areas and for distances up to 100”? Direct scan

5. Which scan technique is best suited to areas of high vibration and where sensing is only possible from one side? Retroreflective scan

6. Which scan technique uses a filter so the light is projected in one plane only? Polarized scan

7. Which scan technique uses a transmitter and receiver mounted at equal angles from a reflective surface? Specular scan

8. Which scan technique utilizes the emitted, reflected light is received? Diffuse scan

9. Which scan technique focuses the light beam to a fixed point in front of a photoreceiver? Convergent beam

10. What are some of the advantages of POF (plastic optical fiber) cables? Withstand higher temps than wire cables, physically tougher (bending) than glass optical fibers, less expensive than glass.

11. What is one disadvantage of POF over glass optical fiber? Glass will handle more data over longer distance

12. What is one advantage of modulated light for a sensor? Not affected by ambient light

13. What is one advantage of unmodulated light? Responds quickly for high-speed counting
14. What is the term used to describe the number of items a controller can detect in a second? 
Response time

15. How is the sensitivity of photoelectric and proximity sensors changed? Sensitivity adjusting screw

16. What is a “dark operated” photoelectric control? Energizes the output switch when a target is present and breaks the light beam

17. Which sensor operates by monitoring high-frequency sound waves? Ultrasonic

18. Which output from an ultrasonic diffuse mode sensor would be used to operate a light that glows with intensity proportional to the target distance from the sensor? Analog or digital

19. Which proximity sensor uses eddy currents to sense an object? Inductive

20. Which proximity sensor is best suited to measure plastic targets? Capacitive

21. What property of a material will affect it being detected with a capacitive proximity sensor? Dielectric constant


24. What are some advantages of a flow detection sensor? No moving parts and no corrosion

25. What sensor produces heat and produces a current based on whether the heat is carried away from the head or not? Flow detection sensor
26. What are the main types of outputs for solid-state switching of AC and DC current? AC-thyristor and DC- NPN or PNP transistor

27. What are some of the considerations when determining the type of output switching device? 1. Voltage (AC or DC) 2. Amount of current to be switched 3. Electrical requirements of device connecting to 4. Polarity of DC output 5. Electrical characteristics of the load

28. What is the typical amperage rating of solid-state sensors? Less than .5 A

29. What is the typical operating current of solid-state sensors? 1.5-7 mA

30. How is the operating current (solid-state sensors) kept from negatively affecting high-impedance loads such as PLCs? Adding a resistor in parallel with the load to reduce overall impedance

31. What is holding current for an electronic sensor? Amount of current required to keep a sensor operating once it is triggered

32. What is the generally accepted rule for the maximum number of solid-state sensors that may be connected in series or parallel? 3

33. What is the difference between sinking and sourcing current for a load? Sourcing is switching the current before it gets to the load. (positive side) Sinking is switching the current after it flows through the load. (negative side)

34. Interference for proximity sensors can come from what two sources? Objects close to the sensor or other sensors

35. What is the basic rule for distance between sensors when mounting flush inductive and capacitive proximity sensors? Minimum of twice diameter of largest
36. What is the basic rule for distance between sensors when mounting non-flush inductive and capacitive proximity sensors? Minimum of three times diameter of largest (center)

37. What is the basic rule for distance between sensors when mounting inductive and capacitive proximity sensors opposite each other? Minimum of six times rated sensing distance

38. What is the “Effective light beam” for a photoelectric sensor? Area of light that travels directly from the transmitter to the receiver

39. Which component of a photoelectric transmitter and receiver should be mounted on the end where the most dirt and debris is in the air? Receiver (less effect than on the transmitter)

40. What is a “Load-powered switch”? Two-wire, solid-state switch.

41. What are some high-impedance loads? PLC and solid-state devices

42. What is the first test when checking a faulty two-wire, solid-state switch? Supply voltage

43. Does the operating current of a three-wire, solid-state switch flow through the switch? No

44. What device is used to prevent reverse polarity when connecting three-wire, solid-state switches in parallel? Diode

45. How is the diode connected in a circuit to prevent damage to contacts when switching inductive loads? Parallel with the load