1. What is a dynamo? Generic term originally given to a rotating machine that converts mechanical energy to electrical energy, primarily in the form of DC.

2. What is the obvious difference between a DC motor and a DC generator? The enclosure is typically open for a generator and closed for a motor.

3. Why are laminations slotted in the armature of a DC machine? House the windings.

4. What are commutator bars and what is their purpose? Convert the internal AC circuit to an external DC circuit.

5. How is the current conducted to and from the armature windings? Commutator and brushes.

6. What are the most common materials for brushes? Carbon or graphite.

7. What is the basis for selecting brush material? Application and cost.

8. What is the typical pressure for brushes against the commutator? 1-2 PSI.

9. What are two methods of producing field poles in a DC generator? Permanent magnets or field coils (DC).

10. Which part of a generator contains the recesses for the bearings and armature shaft? End shields.

11. What is a sealed bearing? Factory lubricated and enclosed.

12. What is the result of too much grease in a bearing? Produce heat and shorten life.

14. What factor limits the use of magnetos? Generate low voltages and can’t vary the voltage with permanent magnets.

15. What are the most common uses for magnetos? Ignition circuits for small engines, meggars, and non-digital tachometers.

16. What do the terms “self-excited” and “separately excited” mean in relation to DC generators? Current for field coils from armature of the generator. (self) Current for field coils from separate DC source. (separate)

17. Which type of winding is made of a few turns of heavy gauge wire? Series

18. What is a shunt winding? Many turns of smaller wire, high resistance, and lower current

19. How is the generator voltage controlled in a shunt generator? Rheostat

20. How are most DC generators excited? Armature of the machine itself

21. Which functions of voltage generation are fixed for a given machine? Number of poles, paths, and active conductors

22. What is the relationship between speed and voltage in a given DC generator? Directly proportional

23. What force is a DC generator dependent on for voltage buildup when first starting? Residual magnetism of the field poles

24. What is “flashing the field” for a DC generator? Separate DC source briefly establishes current through the field coils

25. How should field rheostats be set for startup of a DC shunt generator? Minimum value
26. What is the result of too low speed in the prime mover for a DC self-excited generator? **No voltage buildup**

27. What is armature reaction? **Armature field distorting the main field (field poles)**

28. What is the difference between a mechanical neutral plane and an electrical neutral plane? **Mechanical is 180° into the cycle and parallel to the pole faces. Electrical is slightly shifted (depending on armature current) and is where no lines of force are being cut**

29. What are interpoles or commutating poles? What is their purpose? **Extra poles placed on the mechanical neutral plane to minimize distortion of the main field**

30. Why are compensating windings used less frequently than interpoles in DC generators? **Cost**

31. What are the three types of power losses in a DC generator? **Rotational, core, and copper**

32. What is the formula for efficiency of a DC generator? **Power out/power in**

33. What are the three types of DC generators? **Series, shunt, and compound**

34. What does the letter “F” represent according to the NEMA standard numbering system for lead identification? **Shunt Field Coils**

35. Which end of the shaft is the commutator mounted on? Why? **Opposite of the drive end for ease of maintenance for commutator and brushes**

36. How is the terminal voltage controlled in a DC shunt generator? **Rheostat**

37. What is the formula for percent voltage regulation in a DC generator? **%Voltage Regulation=No Load Volts-Full Load Volts/Full Load Voltsx100**
38. What is the result of a series DC generator with no load connected across the terminals? It is an “open” and no current flows in the armature or field circuits.

39. What happens in a DC series generator when the resistance in the load is decreased? Armature current increases so the series field increases as well.

40. What is the difference between a long shunt and a short shunt compound DC generator? In a long shunt, the shunt is connected across the line (armature and series coil) but in a short shunt it is connected across just the armature coil.

41. What is the difference between a differential and a cumulative compound DC generator? Which one is more common? Cumulative compound is when current flows in the same direction through the series and shunt windings. Differential compound is when the current flows in different directions in the series and shunt windings. Cumulative is more common.

42. What are the characteristics of the three types of cumulative compound DC generators? Flat-Constant or flat with respect to load. Over-compound – Increased turns in series winding rising voltage characteristic. Under-compound – Decreased series turns voltage characteristics between shunt and flat.

43. What is the result of the flux in the series winding of the differential compound DC generator overcoming the flux of the shunt winding? Rapid decrease in terminal voltage.

Unit 2

1. What is “motor effect”? When a conductor carries a current in the presence of a magnetic field a force will act on the conductor at right angles to the field.

2. What is the neutral plane? Area where no lines of force are being cut.
3. How does the armature operate differently in a DC motor and a DC generator?
Generator armature is the source of emf that delivers current to a load. Motor armature is a load that draws current from an external source.

4. What are two methods for reversing a DC compound motor? Reverse the direction of current in the armature or in both the series and shunt windings.

5. What is torque? Twisting or turning force capable of producing rotation about an axis.


7. An induced emf is always in what direction? Opposite to the force that produced it.

8. What is effective voltage? Difference between the applied voltage and the counter emf.

9. Starting resistance in larger DC motors typically limits the current to what value of the FLA? 1.5 x FLA.

10. What is the term used to describe the starting resistors for DC motors and the associated equipment? Reduced-voltage starters.

11. What does a “locked rotor” condition in a DC motor usually indicate? Mechanical problems (bearings, excessive load).

12. If a “locked rotor” condition exists for a period of time, how will it affect a motor? High starting current will remain and overheating can damage the motor.

13. What is the end result when mechanical load is increased on a DC motor? (Up to the stall point) Increase in armature current and torque to balance the extra load.

14. What is the formula for power? $2\pi TN/60$.
15. What is the formula for % speed regulation? \( \frac{N_{NL} - N_{FL}}{N_{FL}} \times 100 \)

16. At what speed does a motor deliver maximum horsepower? Base Speed (No speed control, will vary with load)

17. What is the result of placing a resistance in the shunt field of a DC motor? Motor speeds up (Above base speed)

18. How is a DC motor operated below base speed? How is this control typically provided? Reduce armature current (Resistors or electronic voltage regulators)

19. What are two results of armature reaction? Weakened main field and sparking at the brushes

20. How is sparking, due to armature reaction reduced? Shift brushes opposite to the direction of rotation

21. What is the polarity of interpoles? Same as the one behind it in direction of rotation

22. What is the most effective method for offsetting the effects of armature reaction? Compensating windings. Why is it not typically used for DC motors? Cost

23. What is the armature current for a DC motor with a line voltage of 120 V and a counter voltage of 85 V if the resistance is 4 ohms? 8.75 A

24. What is the armature current for a DC motor with a line voltage of 240 and a counter voltage of 170 if the resistance is 3 ohms? 23.33 A

25. What is the direction of rotation relationship for a DC generator and a DC motor with similar construction? Opposite
26. How is the direction of rotation changed in a DC motor? Reverse the direction of current through the armature or field winding (both series and shunt for compound)

27. Will changing the line terminals change the direction of rotation for a DC motor? No, it changes the direction of current in both the armature and field having no effect on rotation

28. Which type of DC motor is considered a constant speed motor? Shunt

29. What is the condition known as “run away”? Motor accelerating to unsafe speeds due to a loss of field circuit

30. Why should the field of a DC shunt motor never be allowed to open? See Above

31. How do electronic circuits vary the armature current? Varying the voltage to the armature circuit

32. What is the starting torque of a DC shunt motor? Relatively poor

33. What are some of the loads best suited for a DC shunt motor? Paper machines, printing presses, drill presses, lathes, blowers and motor-generator sets

34. Describe a series field winding. Few turns of large wire

35. How is the armature current limited to a value consistent with the required torque in a DC series motor? Solid-state drives limit the current to the armature

36. How is the speed regulation of the DC series motor? Poor

37. What is the only method for controlling the speed of a DC series motor? How is this typically done? Limiting armature current with SS Drives

38. What is the starting torque for a DC series motor? Excellent
39. How should a DC series motor be connected to the load? Direct (no belts or couplings)

40. What are some of the most common applications for a DC series motor? Traction and lifting applications such as cranes, hoists, locomotives, mine haul trucks and automobile starters.

41. Which type of DC motor offers both high starting torque and good speed regulation? Compound

42. Which field in a DC compound motor is considered the main field? Shunt

43. Which type of shunt connection is typically used for compound DC motors? Long shunt

44. Are most DC compound motors cumulative or differential? Cumulative

45. How are DC compound and shunt motors protected from excessive speed in case of a field loss? Over-speed centrifugal switches or field-loss relays

46. What is the torque characteristic of a DC compound motor? Between the torque characteristics of series and shunt depending on the degree of compounding

47. What are some applications for a DC compound motor? Constant speed under varying load conditions such as shears, elevators, presses, compressors

48. What are the two most general categories of operational difficulties in DC motors? Electrical faults or mechanical faults

49. What is the first check on a motor that is not operating properly? Check supply voltage and that armature and field poles are connected properly

50. What meter is used to check for grounds and insulation breakdown in a motor? Megger
51. Where is a short circuit most likely to occur in a DC motor? Armature

52. What is a growler? Device that produces a strong alternating magnetic field

53. What are some of the most common mechanical problems with motors? Worn bearings, armature imbalance, improper alignment of motor and load, loose coupling between motor and load, loose mounting bolts and unbalanced load.

54. What is a “dial indicator”? Device used for checking shaft alignment

**Unit 3**

1. Why does a controller for a DC motor require a special rating? Persistent arcing when contacts open (More persistent than AC)

2. What are the three main functions of DC motor controllers? 1 - Start stop and reverse DC motor. 2 – Control motor starting current and torque. 3 – Provide the correct operating sequence and speed control of the driven mechanical system

3. What is a “drum controller”? Manual switch with contacts mounted on a cylinder for stopping, starting, and reversing a motor

4. What are the two types of faceplate starters? Three-terminal and four-terminal

5. What type of protection is provided for DC motors with a three terminal faceplate starter? No-field protection

6. What is the moveable part of a magnetic starter called? Armature

7. How is the coil in a DC magnetic starter protected from overheating using an auxiliary contact? Insert a resistor in series with the armature once it has hauled in

8. What principle is the blow-out coil in a DC starter based on? Motor effect

9. What is considered the “heart” of the DC motor controller? Silicone Controlled Rectifier (SCR)
10. Why is it necessary to coordinate the controller with the DC motor? Optimize performance.

11. Why is three-wire control typically used for DC motor control circuits? Provide under-voltage protection.

12. What is the purpose of the sealing contact in a motor starter? So you don’t have to hold the start button to keep the motor running.

13. What are three conditions that will stop a motor operated by a magnetic starter? 1. Loss of voltage. 2. Operation of the stop button. 3. Operation of the overload relay.

14. What is current limit acceleration? Inserting and removing resistance to the armature circuit during acceleration up to normal speed.

15. How is the degree of acceleration in a DC motor measured for current limited acceleration? Voltage buildup across the armature.

16. Why are accelerator relays equipped with adjustable pick-up and drop-out relays? Motor design and load conditions change requirements.

17. What is the guideline for adjusting the drop-out relay for current limit acceleration? Adjust to keep relay from picking up when heavy loads are applied to the motor.


20. What is a dashpot timer and how is it adjusted? Forcing a fluid through a small opening adjusted by size of opening.
21. What does NOTO mean for a contact in a diagram? Normally open, timed to open

22. What is the purpose of the check valve in a dashpot timer? Reset faster

23. What are the main parts of a pneumatic timer? Solenoid, Armature, bellows, adjustment valve, spring, check valve, timing contact, and air inlet

24. When is the coil of the timing relay energized in a definite-time relay? When the coil is energized

25. What is the result of a starting resistor staying in the circuit too long due to a wrong adjustment? Overheating and damage

26. What are some advantages of solid-state timers for DC motor controllers? Less maintenance and more dependable (No moving parts)

27. What happens when the shunt field in a DC motor opens? Motor may accelerate to unsafe speeds

28. Where is the field loss relay connected in the DC motor starter? Series with the shunt field with a contact in series with the holding contact

29. What must the field loss relay coil be matched to for proper protection and motor operation? Current requirement of the shunt field

30. Why are the armature leads typically switched to reverse a DC motor? Easier than changing both the series and shunt fields

31. What precaution must be taken when speed control and field-loss protection are incorporated into a control circuit for a DC motor? Rheostat must be set so at the lowest setting it will not drop out the field loss relay
32. What are some features of solid-state DC motor controllers not available on typical magnetic starters? Reversing, variable speed control, and regenerative braking.

33. What is the definition of “Power converters”? Assembly of rectifying, filtering, and regulating components that convert AC supply to DC.

34. What device is used to construct the standard three-phase bridge rectifier? PN Junction diodes.

35. Why are separate power supplies used for the field and armature in a DC solid-state controller? Smoother speed control.

36. What is the advantage of having the shunt field energized when the motor is not operating? Provides a small amount of heat to keep moisture from condensing in the windings of the motor.

37. What are the two purposes of armature voltage control? Limit inrush current and provide speed control during operation.

38. How is the DC output voltage actually controlled? Controlling the armature voltage.

39. What is the purpose of the freewheeling diode in a DC motor controller? Prevent a high-voltage spike across the armature from a collapsing magnetic field.

40. Which part of a DC motor controller provides loss of field protection? Resistor in series with the shunt field shuts down the SCRs.

41. How is current-limit protection provided in a DC motor controller? Current transformers on the input lines provide a signal to a control unit.
42. What device in a DC motor controller will disconnect the motor in the event of a stall? Control unit

43. How is speed control of a DC motor achieved using a magneto? Magneto sends a signal to the control unit proportional to speed and it adjusts the armature voltage

44. What are some situations where braking of a motor is important? Hold a load in case of loss of power (crane, elevator, etc.)

45. How are most braking systems on electric motors operated? Mechanical systems controlled electrically

46. What does the term “fail safe” mean in relation to braking? Power loss results in brakes being on

47. Where does the energy come from for dynamic braking? Armature acting as a generator

48. Why is the shunt field not disconnected when the motor stops in a DC dynamic braking system? Shunt field is required for the motor to operate as a generator

49. What is the counter-torque proportional to in a dynamic braking system? Speed of the armature

50. What is the purpose of an off-delay relay in a dynamic braking system? Allow the shunt field to be disconnected after the braking

51. What is the main disadvantage of dynamic breaking? Energy lost as heat dissipated in the braking resistor

52. What is regenerative braking? Stores energy for future use (Battery, etc)

53. What are the two fundamental steps in troubleshooting motors? Visual Inspection and meter testing
54. What are some symptoms to look for in a visual inspection? Tripped circuit breaker or overloads, burnt or discolored components, loose connections, mechanical problems such as binding or bearings

55. What is the best way to test a motor for faults to ground? Megger

56. What are some tests for the mechanical workings of a magnetic starter? Operate them manually and check for binding and distance of travel

57. Why should magnetic starters not be started manually by pushing in the moveable portion? Motor starts and seals in

58. Is a shading coil required in a DC magnetic motor starter? No

59. Is arcing worse in AC or DC magnetic starters? DC

60. Silver-faced contacts should be filed and dressed regularly. True or False?

61. What are possible causes of a magnetic starter not sealing in? Low voltage, coil shorted or broken, wrong coil