2 MARKS QUESTION AND ANSWERS

DC MOTORS

1. **What is the basic difference between DC generator and DC motor?**

   Generator converts mechanical energy into electrical energy. Motor converts electrical energy into mechanical energy. But there is no constructional difference between the two.

2. **What is the basic principle of operation of DC motor?**

   When a current carrying conductor is placed in a magnetic field, a mechanical force is exerted on the conductor which develops the torque.

3. **What is torque proportional to?**

   Torque is proportional to the interacting fields and to the sine of the electrical space angle between their magnetic axes

4. **Distinguish between shunt and series field coil constructions.**

   Shunt field coils are wound with wires of small cross section and have more number of turns. Series field coils are wound with wires of larger cross section and have less number of turns.

5. **How does a DC motor differ from DC generator in construction?**

   Generators are normally placed in closed room, accessible only to skilled operators. Therefore on ventilation point view they may be constructed with large opening in the frame. Motors on the other hand, have to be installed right in the place of use which may have dust, dampness, inflammable gases, chemical fumes etc. To protect the motors against these elements, the motor frames are made either partly closed or totally closed orflame proof etc.

6. **How will you change the direction of rotation of a DC motor?**

   Either the direction of the main field or the direction of current through the armature conductors is to be reversed.

7. **What is back emf in DC motors?**

   As the motor armature rotates, the system of conductor come across alternate North and South pole magnetic fields causing an emf induced in the conductors. The direction of the emf induced in the conductors. The direction of the emf induced is in the direction opposite to the current .As this emf always opposes the flow of current in motor operation it is called back emf.

8. **Write down the equation for back emf of DC motor.**

$$E_b = P \varphi Z N / 60 A, [Volts]$$

9. **Write down the equation for torque developed in DC motor.**

$$T_d = \square I_a Z P / 2\square A , [N-M)$$

$$T_d \alpha \varphi I_a$$

10. Why DC motors are not operated to develop maximum power in practice?

- The current obtained will be much higher that the rated current
- The efficiency of operation will be below 50 %

11. Under what condition the mechanical power developed in a DC motor will be maximum?

Condition for mechanical power developed to be maximum

is$E_b = V_a /2$ or $I_a = V_a / 2R_a$

12. Why shaft torque is always less than that developed inside the armature in a DCmotor?

Mechanical power developed inside the armature is

$$P_d = E_b I_a = 2\pi N T_d /$$

60Mechanical power output available on the shaft is

$$P_o = 2\pi NT / 60$$

$$P_d – P_o = W_i + W_m$$

Therefore shaft torque T is less than torque developed in the armature T_d to meet the ironloss W_i and mechanical loss W_m.

13. Why is the starting current high in a DC motor?

The absence of back emf at the time of starting causes the armature current to shoot up to about 20 times the normal current, if no limiting resistance is included.

14. What is the need for starter in a DC motor?

Starters are used in DC motors to limit the high starting current within about 2 to3 times the rated current by adding resistance in series with the armature circuit. Apart from starting resistances, starters are invariably fitted with protective devices such as no voltage protection and over-load protection.

15. What is the function of over-load release coil provided in a DC motor starter?

Due to any overload in the motor, if the line current increases above a preset value, the excess magnetic force causes the lifting of an iron piece. As the iron piece makes an upward movement, a contactor fitted along with it causes the two terminals of NVR coil to get short circuited. Hence the electromagnet fitted with NVR coil loses its magnetic force and releases the starter handle from the ON position towards OFF position, thus protecting the motor against over-load.

16. What is the function of a no-voltage release coil provided in a DC motor starter?

As long as the supply voltage is on healthy condition the current through the NVR coil produce enough magnetic force of attraction and retain the starter handle in the ON position against spring force. When the supply voltage fails or becomes lower than a prescribed value the electromagnet may not have enough force and the handle will come back to OFF position due to spring force automatically. Thus a no-voltage or under voltage protections are given to the motor.

17. How does 4 point starter differ from 3 point starter?

In 3 point starter, NVR coil is connected in series with the shunt field coil. The

exciting current through the NVR coil in 3 point starter is same as the shunt field current of the motor. In 4 point starter, NVR coil along with a high resistance connected across the supply voltage. Thus the exciting current through NVR coil of a 4 point starter is purely proportional to the supply voltage and independent of shunt field current.

18. Enumerate the factors on which the speed of a DC motor depends.

$$N = E_b / \varphi$$
$$= (V_a - I_a R_a)/ \varphi$$

The speed of dc motor depends on three factors.

- Flux in the air gap
- Resistance of the armature circuit
- Voltage applied to the armature

19. List the different methods of speed control employed for DC series motor.

- Field diverter method
- Regrouping of field coils
- Tapped field control
- Armature resistance control
- Armature voltage control for single motor
- Series parallel control for multiple identical motors

20. Draw the N Vs E_b characteristics of a dc motor for two different field currents.

21. What is the relation between electrical degree and mechanical degree?

Electrical degree θ_e and mechanical degree are related to one another by the number of poles P, the electrical machine has, as given by the following equation. $\theta_e = (P/2)\ \theta_m$

22. What is the meaning of electrical degree?

Electrical degree is used to account the angle between two points in rotating electrical machines. Since all electrical machines operate with the help of magnetic fields, the electrical degree is accounted with reference to the polarity of magnetic fields. 180 electrical degrees is accounted as the angle between adjacent North and South poles.

23. List out some examples of prime movers.

I.C. Engines, Steam engine, Turbine or Electric Motors.

24. Give some applications of DC motor.

Shunt : driving constant speed, lathes, centrifugal pumps, machine tools, blowersand fans, reciprocating pumps

Series : electric locomotives, rapid transit systems, trolley cars, cranes and hoists, conveyors

Compound : elevators, air compressors, rolling mills, heavy planners.

25. Explain how the back emf of a motor causes the development of mechanical power?

P_{mech}So it is power absorbed by E_b that gets converted to mechanical form.

26. Why a differentially compound motor is not used in practice?

As the motor is loaded, the series winding reduces the flux produced by the shuntwinding and so its N-T characteristic curves are upwards. Under accidental overload, flux / pole tend to zero and motor speed can increase to dangerous values. Hence they are not used inpractice.

27. What do you mean by constant torque operation and constant HP operation of speedcontrol in DC shunt motor?

Constant torque operation of speed control is Armature control method and constant HP method is Field control method.

Speed and torque equations of DC motor are

$N = K_N (V_a – I_aR_a)/$

$= K_N V_a /$ as armature drop is neglected

$T = K_T \square I_a$

At load torque $T_L = T_{motor}$ at base speed N_b, apply full voltage to field; so $I_f = I_{f(max)}$. Adjust armature voltage V_a to rated value. With field remaining fixed for constant torque, I_a should remain fixed at rated value. For speeds above rated value, reduce V_a, the speed reducesas per the first equation, the motor draws rated I_a at constant load torque. The speed cannot be raised above N_b as rated I_a cannot be exceeded unless the torque is allowed to be reduced.

Keeping V_a at rated value if I_f is reduced, the speed would increase but torque would reduce. This indeed is constant Hp drive.

28. State one advantage and disadvantage in the application of each of the three basic types of DC motors.

a. Shunt Motor:

Advantage: Substantially constant speed i-e low speed regulationDisadvantage:
Cannot be used for constant speed application

b. Series Motor:

Advantage: High torque low speed (at start) and low torque at high speed. This istypical requirement for traction type of load

Disadvantage: Accidental no load can cause the motor to run at dangerously highspeed.

c. Compound Motor:
Advantage: Negligible speed regulation for cumulatively compound motor.Disadvantage: Higher cost.

29. List all the important information on name plate of a DC motor.

kW, nominal speed, armature current, insulation class.

30. Why field control is considered superior than armature control method of DC shuntmotor?

a.The regulating resistance which has to carry only a small current is easily available.
b.Power wasted in regulating the resistance is very small and hence this method is more economical.