DC MACHINE QUESTION AND ANSWER

Q: What are the essential parts of DC machine?

A:

1. Magnetic frame or yoke
2. Poles
3. Armature
4. Commutator
5. pole shoes
6. armature windings
7. interpoles
8. Brushes
9. bearings
10. shaft

Q. What is the purpose of yoke in d.c machine?

1.It acts as a protecting cover for the whole machine and provides mechanical support for the poles.
2.It carries magnetic flux produced by the poles

Q. What is the purpose of Field pole in d.c machine?

To produce flux with the help of field winding

Q. What is the purpose of Field winding in d.c machine?

To produce flux

Q. What is the purpose of pole shoes in d.c machine?

1. They support field coil
2.Decrease reluctance
3.Increase cross section area of magnetic circuit

Q. What is the purpose of Armature core in d.c machine?

To store armature windings and provide the path for main flux

Q. What is the purpose of Armature winding in d.c machine?

To develop main electrical power

Q. Why the armature core in d.c machines is constructed with laminated steel sheets instead of solid steel sheets?

Lamination highly reduces the eddy current loss and steel sheets provide low reluctance path to magnetic field i.e decreases hysteresis loss

Q.What is the purpose of brushes?

Its function is to collect current from commutator and supply to external load circuit

Q: What are the materials used for brushes in dc machines?

1. Natural graphite
2. Electro graphite
3. Hard carbon
4. Metal graphite

Q.Why the brushes are made of carbon?

1.To some extent carbon brush can act as a self lubricating brush;
2.On moment, polishes the commutator segments;
3.Damage to the commutators is less then when copper brushes are used on occurrence of sparkover.

Q: How to design the number of brushes for a dc machine?

The numbers of brush locations are decided by the type of winding. In lap winding the number of brush locations is equal to number of poles and in wave winding it is always two. In each location there may be more than one brush mounted on a Spindle, whenever the current per brush location is more than 70A. Hence the number of brushes in a spindle is selected such that each brush does not carry more than 70A.

Q:What is the function of bearings?

To reduce friction and thereby help in smooth and easy rotation.

Q What is meant by self excited and separately excited dc generator?

•Self-excited generator are those whose field magnets are energized by the current produced by the generator themselves.
•Separately excited generator are those whose field magnets are energized from an independent external source of dc current.

Q:How can one differentiate between long shunt compound generator and short shunt compound generator?

In a short shunt compound generator, only shunt field winding is in parallel with the armature winding. In a long shunt compound generator shunt field winding is in parallel with both series field and armature winding.

Q:What is cumulative compound dc machine?

A compound wound DC machine is said to be cumulatively compounded when the shunt field flux produced by the shunt winding assists or enhances the effect of main field flux, produced by the series winding. $\Phi_{total}=\Phi_{series}+\Phi_{shunt}$

Q:What is differentially compound dc machine?

A compound wound DC machine is said to be differentially compounded

when the flux due to the shunt field winding diminishes the effect of the main series winding. This particular trait is not really desirable, and hence does not find much of a practical application.

$\Phi_{total}=\Phi_{series}--\Phi_{shunt}$

Q: Explain the principle of DC generator.

It is based on Faraday's law of Electromagnetic Induction i.e Whenever a conductor cuts magnetic lines of force , an emf is induced in the conductor.

Q. Write down the emf equation for d.c.generator?

E= (ΦNZ/60)(P/A)V.
p---------no of poles
Z---------Total no of conductor
Φ---------flux per pole
N---------speed in rpm.

Q: Mention the two types of winding used in the dc machines.

1. Lap winding ; used for low voltage, high current machine
2. Wave winding ; used for high voltage, low current machine

	LAP winding	WAVE winding
1.	Number of Parallel paths = Number of Poles	Number of parallel paths=2
2.	Number of brush pairs= Number Of poles	Number of Brush pairs= 2
3.	used for low voltage, high current machine	used for high voltage, low current machine
4.	Ends of armature coil are connected to adjacent commutator segments	Ends of armature coil are connected to commutator segments some distance apart.
5.	It requires equalizing connection	It does not requires equalizing connection
4.	It does not require dummy coil	It requires dummy coil
5.	Resultant pitch= Back pitch – front pitch	Resultant pitch= Back pitch + front pitch

Q: What are dummy coils?

The addition of dummy coils is done in case of small machines for getting the mechanical balance

Q: What is meant by equalizer connections?

In lap winding, due to the difference in the induced emf in various parallel paths, there may be circulating currents in brushes and winding. The connections that are made to equalize the difference in induced emf and to avoid circulating currents through brushes are called equalizer connections.

Q. How are armatures windings are classified based on placement of coil inside the armature slots?
Single and double layer winding

Q: What is meant by commutation?
The process of current reversal in a coil is called commutation.

Q:What is the purpose of mica strip between two adjacent commutator segments?
Mica is placed in between two commutator segments in order to insulate the segments from each other.

Q: What type of copper is used for commutator segments?
A:The commutator segments are made of hard drawn copper or silver copper(0.05% silver)

Q: Why square pole is preferred?
If the cross section of the pole body is square then the length of the mean turn of field winding is minimum. Hence to reduce the copper requirement a square cross section is preferred for the poles of the dc machines.

Q: What is the purpose of slot insulation?
A:The conductors are placed on the slots in the armature. When the armature rotates the insulation of the conductors may damage due to vibrations. This may lead to a short circuit with armature core if the slots are not insulated.

Q: What is Pole Pitch?
It is the distance between two adjacent poles

Q: What is Coil Pitch?
It is the distance in terms of slots between two sides of coil.

Q:What is full pitched coil?
If the coil pitch is equal to pole pitch then it is termed as Full pitched coil

Q:What is fractional pitched coil?
If the coil pitch is less than pole pitch then it is termed as Fractional pitched coil

Q: What is Back Pitch?
It is the distance measured in terms of armature conductors away from commutator.

Q: What is Front Pitch?
It is the distance measured in terms of armature conductors between coil sides connected to same commutator segment.

Q: What is Resultant Pitch?
It is the distance measured in terms of armature conductors between beginning of 1 coil & beginning of next coil.

Q: What is Commutator Pitch?
It is the distance measured in terms of commutator segments which the two ends of coil are connected**.**

Q:How to calculate number of conductors?
Number of conductors= number of slots x number of conductors per slot.

Q. Distinguish between shunt and series field coil construction?
Shunt field coils are wound with wires of small section and have more no of turns.
Series field coils are wound with wires of larger cross section and have less no of turns.

Q: How is the voltage built up in shunt generator?
Generator is rotated by prime mover , due to presence of flux emf is induced by Faraday's law of Electromagnetic induction
Current will also flow through field winding , hence more flux is produced , so more emf is induced in armature so again more field current and hence more flux. This process continues.

Q.What do you mean by residual flux in DC generator?

The magnetic flux retained in the poles of the machine even without field supplies called the residual flux.

Q.What is critical resistance of a DC shunt generator?
The resistance of field winding at which the generator just excites for a given speed and starts voltage building is called critical resistance.

Q.What is critical speed of a DC shunt generator?
The speed for which the given field winding resistance act as critical resistance is called as critical speed.

Q.What are the conditions to be fulfilled for a shunt generator to build up voltage?

a)There must be some residual magnetism in the field poles.
b)The shunt field resistance should be less than critical resistance.
c)The field coils should be connected with the armature in such a way that current flowing through them should increase the emf induced by the residual magnetism.

Q. Why is the emf not zero when the field current is reduced to zero in dc generator?

Even after the field current is reduced to zero, the machine is left out with some flux as residue so emf is available due to residual flux.

Q. On what occasion dc generator may not have residual flux?

The generator may be put for its operation after its construction, in previous operation, the generator would have been fully demagnetized.

Q.A DC generator fails to self excite. List the cause for the failure

a)Residual magnetism may not be there in the poles
b)Direction of rotation may be wrong
c)The field resistance may be more than critical resistance
d)There may be disconnection in the field winding
e)Brush contact may be poor
f)The field coils may be connected with the armature to oppose the emf due to residual magnetism

Q: Which losses have highest proportion in DC machine?

Armature copper loss has highest proportion of 30 to 40% of losses.

Q: What is the condition of maximum efficiency in Dc Machine?

Variable losses= constant loss

Q: What is core loss? What is its significance in electric machines?

When a magnetic material undergoes cyclic magnetization, two kinds of power losses occur on it. Hysteresis and eddy current losses are called as core los s. It is important in determining heating, temperature rise, rating & efficiency of transformers, machines & other A.C run magnetic devices.

Q what do you mean by hysteresis loss?

The magneto motive force or mmf applied in the core is alternating. For every cycle due to this domain reversal, there will be extra work done. For

this reason, there will be a consumption of electrical energy which is known as Hysteresis loss.

Q. What is eddy current loss?
When a magnetic core carries a time varying flux, voltages are induced in all possible path enclosing flux. Resulting is the production of circulating f lux in core. These circulating current do no useful work are known as eddy current and have power loss known as eddy current loss.

Q:How hysteresis and eddy current losses are minimized?
Hysteresis loss can be minimized by selecting materials for core such as silicon steel & steel alloys with low hysteresis co-efficient and electrical resistivity. Eddy current losses are minimized by laminating the core.

Q:What are factors on which hysteresis loss?
It depends on magnetic flux density, frequency & volume of the material.

Q: What is the overall efficiency of DC generator?
95%

Q:Differentiate between geometric neutral axis (GNA) and magnetic neutral axis (MNA).
GNA is the axis which is situated geometrically or physically in the mid way between adjacent main poles. MNA is the axis which passes through the zero crossing of the resultant magnetic field waveform in the air gap.

Q. Define armature reaction in dc machines?
The interaction between the main flux and armature flux cause distur bance called as armature reaction.

Q: What are the effects of armature reaction?
A:The various effect of armature reaction are :
1 Due to demagnetizing effect, generated emf is reduced
2Magnetic flux density increases over one of pole and decrease over other half , hence total flux decreases and so terminal voltage decreases.
3Due to high magnetic flux density , maximum voltage between adjacent commutator segments occur , resulting in sparking
4. Flux wave is distorted & there is shift in position of MNA in direction of rotation for generator and against direction of rotation for motors.

Q: What are the methods to eliminate armature reaction effect?
1. Provide Extra De- magnetizing AT on field windings
2. Using compensating winding

Q:What are compensating winding?
Auxilliary windings placed in slot of pole shoe connected in series with armature winding in such a way that flux produced by them is in opposition to armature flux.

Q:What is commutation?
The process by which current in short circuit coil is reversed while it crosses MNA.

Q.Name the two methods of improving commutation.
•Emf commutation(Brush shift and use of interpoles)
•Resistance commutation

Q.What is reactance emf in dc machine?
The self induced emf in the coil undergoing commutation which opposes the reversal of current is known as reactance emf.

Q: What are Interpoles?
These are small poles fixed to yoke in between main poles & its winding is connected in series with armature winding.

Q:To what polarity are the interpoles excited in dc generators?
The polarity of the interpoles must be that of the next main pole along the direction of rotation in the case of generator.

Q: How can the voltage in a DC generator be increased?
Increasing the main field flux and the speed of the armature can increase the voltage in a DC generator

Q: Give application of all types of DC generators.
Separately excited : Electro-platting, Electro –refining
DC shunt- Battery charging and lighting purpose
DC series- Booster & braking of DC locomotives
Dc cumulative-Transmission of power and domestic lighting purpose
Dc differential- Electric arc welding

Q. How does d.c. motor differ from d.c. generator in construction?
Generators are normally placed in closed room and accessed by skilled operators only. Therefore on ventilation point of view they may be constructed with large opening in the frame.
Motors have to be installed right in the place of use which may have dust, dampness, inflammable gases, chemical etc. to protect the motors against these elements the motor frames are used partially closed or totally closed or flame proof

Q: List all the important information on name plate of a DC motor.
kW, nominal speed, armature current, insulation class.

Q: What is working principle of DC motor?
When a current carrying conductor is placed in magnetic field it experiences force.

Q. How will you change the direction of rotation of d.c.motor?
Either the field direction or direction of current through armature conductor is reversed.

Q. What is back emf in d.c. motor?
When dc motor is given supply it starts to rotate, due to this the armature conductor cut the magnetic flux hence the emf is induced in the armature conductor which oppose the main supply. This induced emf is called Back emf.

Q: What are the factors affecting torque?
$T=PIZ\ \Phi\ /\ 2\pi A$
Number of poles (p)
Number of parallel paths(A)
flux (Φ)
Number of conductors (Z)
Armature current(Ia)

Q:Define : Speed regulation.
It is defined as ratio of speed from no load to full load and full load speed.

Q: Why dc shunt motor is called constant flux or constant speed motor?
In DC shunt motor flux produced is proportional to field current. The input voltage is constant so the field current is also constant hence flux is also constant.

Q: Why dc series motor should not be started at no load.
Because its starting speed is very high.

Q:Which type of motor is used for traction ? why?
Dc series motor is used for traction purpose because its starting torque is high.

Q. Enumerate the factors on which speed of a d.c.motor depends?
$N= (V-IaRa)/\Phi$

so speed depends on voltage applied to armature, flux per pole, resistance of armature.

Q: What are the various methods of controlling speed?
1.Field control method
2. Armature control method
3. Ward Leonard method

Q.Why field control is considered superior than armature control method of DC shunt motor?

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

Q.Under what condition the mechanical power developed in a dc motor will be maximum?.
The ratio of back emf to applied voltage is 0.5

Q.Why is the starting current high in a DC motor?
The absence of back emf at the time at starting causes the armature current to shoot up to about 20 times the normal current, if no limiting resistance is included.

Q.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 to 3 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.

Q.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.

Q.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.

Q.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

Q: What are the different types of tests done on DC motor?

1.Brake test
2.Swinburne's test
3. Field test

Q.Give some applications of DC motor.

Shunt : driving constant speed, lathes, centrifugal pumps, machine tools, blowers and fans, reciprocating pumps
Series : electric locomotives, rapid transit systems, trolley cars, cranes and hoists,conveyors
Compound : elevators, air compressors, rolling mills, heavy planners.

Q:State one advantage and disadvantage in the application of each of the three basic types of DC motors

Shunt Motor:Advantage: Substantially constant speed i-e low speed regulation
Disadvantage: Cannot be used for constant speed application

Series Motor:Advantage: High torque low speed (at start) and low torque at high speed. This is typical requirement for traction type of load
Disadvantage: Accidental no load can cause the motor to run at dangerously high speed.

Compound Motor:Advantage: Negligible speed regulation for cumulatively compound motor

Disadvantage: Higher cost.

Q:Why a differentially compound motor is not used in practice?

In differential compound motor, as two fluxes oppose each other, the resultant flux decreases as load increases, thus the machine runs at a higher speed with increase in the load. This property is dangerous as on full load, the motor may try to run with dangerously high speed. So differential compound motor is generally not used in practice.