ST. ANNE'S COLLEGE OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

EE8301 ELECTRICAL MACHINES – I

2 MARKS QUESTIONS AND ANSWERS

UNIT-1
MAGNETIC CIRCUITS AND MAGNETIC MATERIALS

1. What is magnetic circuit?
The closed path followed by magnetic flux is called magnetic circuit

2. Define magnetic flux?
The magnetic lines of force produced by a magnet is called magnetic flux it is denoted as Φ and its unit is Weber

3. Define magnetic flux density?
It is the flux per unit area at right angles to the flux it is denoted by B and unit is
Weber/m2

4. Define magneto motive force?
MMF is the cause for producing flux in a magnetic circuit. the amount of flux setup in the core decent upon current(I)and number of turns(N).the product of NI is called MMF and it determine the amount of flux setup in the magnetic circuit.
MMF=NI ampere turns (AT)

5. Define reluctance?
The opposition that the magnetic circuit offers to flux is called reluctance. It is defind as the ratio of MMF to flux. It is denoted by S and its unit is AT/m

6. What is retentivity?
The property of magnetic material by which it can retain the magnetism even after the removal of inducing source is called retentivity

7. Define permeance?
It is the reciprocal of reluctance and is a measure of the cause the ease with which flux can pass through the material its unit is wb/AT

8. Define magnetic flux intensity?
It is defined as the mmf per unit length of the magnetic flux path. it is denoted as H and its unit is AT/m
H=NI/L

9. Define permeability?
Permeability of a material mean its conductivity for magnetic flux. Greater the permeability of material, the greater its conductivity for magnetic flux and vice versa

10. Define relative permeability?

It is equal to the ratio of flux density produced in that material to the flux density produced in air by the same magnetizing force

$\mu r = \mu / \mu o$

11. What is meant by leakage flux?

The flux does not follow desired path in a magnetic circuit is called leakage flux

12. What is leakage coefficient?

Leakage coefficient=total flux/useful flux

13. State faradays law of electromagnetic induction

Whenever a flux linking in the coil changes emf always induced in the conductor the magnitude of induced emf is proportional to rate of change flux linkage

$e = N d\Phi/dt$

14. State Lenz law?

The law states that induced emf always opposite to applied voltage source

15. Define self-inductance?

The property of a coil that opposes any change in the amount of current flowing through it is called self-inductance

16. Define mutual inductance?

The property of a coil to produce emf in a coil due to change in the value of current or flux in it is called mutual inductance

17. Define coefficient coupling?

It is defined as the fraction of magnetic flux produced by the current in one coil that links the other coil

18. Give the expression for hysteresis loss and eddy current loss?

Hysteresis loss=kh b max1.62fv watts

Eddy current loss=kebmax2f2t2v watts/unit volume

19. What is dynamically induced emf?

An induced emf is produced by the movement of the conductor in a magnetic field. this emf is called dynamically induced emf. The dynamically induced emf

$e = Blv\sin\Theta$

20. What is fringing effect?

It is seen that the useful flux passing across the air gap tends to buldge outwords, thereby increasing the effective area of the air gap and reducing the flux density in the gap is called fringing effect

21. State two types of IM?

1. Squirrel cage IM
2. Slip ring IM

22. State ohms law for magnetic circuits?
Ohms law for magnetic circuits mmf=flux X reluctance

23. What is statically induced emf?
Conductor is stationary and the magnetic field is moving or changing the induced emf is called stationary induced emf

24. How eddy current losses are minimized?
By laminating the core'

25. State types of electrical machines?
1. DC machines
2. AC machines
3. Special machines

26. What is mean by stacking factor?
Magnetic cores are made up of thin, lightly insulated laminations to reduce the eddy current loss. As a result, the net cross sectional area of the core occupied by the magnetic material is less than its gross cross section; their ratio being is called the stacking factor. The stacking value is normally less than one .its value vary from 0.5 to 0.95 .the stacking factor value is also reaches to one as the lamination thickness increases.

27. What are the magnetic losses?
1. Eddy current loss
2. Hysterisis loss

28. Types of induced emf?
1. Dynamically induced emf
2. Statically induced emf

29. What are quasi-static field?
The field pattern in space is fixed. But the field intensity at every point varies as a replica of the time variation of current.

30. Clearly define MMF and EMF.
MMF
It is the driving force required to drive the magnetic flux through a magnetic circuit. The product of NI is called magneto motive force. Its unit is Ampere turns.
MMF= NI (AT)
EMF
Whenever the magnetic flux linking a conductor changes, an emf is always induced in it. The magnitude of induced emf is proportional to the rate of change of flux linkage.

$$e = N\frac{d\phi}{dt}$$

31. Mention the materials suitable for fabrication of permanent magnets.
1. Ferrite magnets

2. Cobalt- Samarium
3. Alnicos
4. Ceramics
5. Neodiyum

32. Define stacking factor.
Magnetic cores are made up of thin, lightly insulated laminations to reduce the eddy current loss. As a result, the net cross sectional area of the core occupied by the magnetic material is less than its gross cross- section; their ratio is called stacking factor.

33. What is meant by statically induced EMF?
The conductor is held stationary and the magnetic field is moving or changing. The emf induced in the conductor during this condition is called as statically induced emf.

34. State Ampere's law.
It says that the magnetic field created by an electric current is proportional to the size of that electric current with a constant of proportionality equal to the permeability of free space.

35. What is hysteresis loss?
The movement of tiny magnets causes a frictional effect between the molecular substances inside the material which results in the formation of heat. This phenomenon is called as hysteresis loss.

36. Define flux linkage.
Flux which links the conductor is called as flux linkage.

37. What is meant by magnetic saturation?
In some magnetic materials, saturation is the state reached when an increase in applied external magnetic field (H) cannot increase the magnetization of material further.

UNIT-2
TRANSFORMERS

1. Define a transformer?
A transformer is a static device which changes the alternating voltage from one level to another.

2 What is the turns ratio and transformer ratio of transformer?
Turns ratio = N2/ N1
Transformer = E2/E1 = I1/ I2 =K

3. Mention the difference between core and shell type transformers?

core type	shell type
The windings surround the core	Core surrounds the windings i.e winding is placed inside the core
It has two limbs, two yokes, one window.	It has three limbs, one center limb and two outer limb, two yokes and one window.

Around each limb half of LV coils and half of HV coils are housed.	The entire LV and HV are housed around the center limb.

4. What is the purpose of laminating the core in a transformer?
In order to minimize eddy current loss.

5. Give the emf equation of a transformer and define each term?
Emf induced in primary coil E1= 4.44fΦmN1 volt
Emf induced in secondary Coil E2 =4.44 fΦmN2. f----------freq of AC input
Φ---------maximum value of flux in the core
N1, N2----Number of primary & secondary turns.

6. Does transformer draw any current when secondary is open? Why?
Yes, it (primary) will draw the current from the main supply in order to magnetize the core and to supply for iron and copper losses on no load. There will not be any current in the secondary since secondary is open.

7. Define voltage regulation of a transformer?
When a transformer is loaded with a constant primary voltage, the secondary voltage decreases for lagging PF load, and increases for leading PF load because of its internal resistance and leakage reactance. The change in secondary terminal voltage from no load to full load expressed as a percentage of no load or full load voltage is termed as regulation.
%regulation =E2-V2/E2 *100
V2>E2 for leading p.f load
V2<E2 for lagging p.f load

8. Define all day efficiency of a transformer?
It is computed on the basis of energy consumed during a certain period, usually a day of 24 hrs. All day efficiency=output in kWh/input in kWh for 24 hrs.

9. Why transformers are rated in kVA?
Copper loss of a transformer depends on current & iron loss on voltage. Hence total losses depend on Volt-Ampere and not on PF. That is why the rating of transformers is in kVA and not in kW.

10. What determines the thickness of the lamination or stampings?
1. Frequency
2. Iron loss

11. What are the typical uses of auto transformer?
1. To give small boost to a distribution cable to correct for the voltage drop.
2. as induction motor starter.

12. What are the applications of step-up & step-down transformer?
Step-up transformers are used in generating stations. Normally the generated voltage will be either 11kV. This voltage (11kV) is stepped up to 110kV or 220kV or 400kV and transmitted through transmission lines (simply called as sending end voltage).

Step-down transformers are used in receiving stations. The voltage are stepped down to 11kV or 22kV are stepped down to 3phase 400V by means of a distribution transformer and made available at consumer premises. The transformers used at generating stations are called power transformers.

13. How transformers are classified according to their construction?

1. Core type 2.shell type. In core type, the winding (primary and secondary) surround the core and in shell type, the core surround the winding.

14. Explain on the material used for core construction?

The core is constructed by sheet steel laminations assembled to provide a continuous magnetic path with minimum of air gap included. The steel used is of high silicon content sometimes heat treated to produce a high permeability and a low hysteresis loss at the usual operating flux densities. The eddy current loss is minimized by laminating the core, the laminations being used from each other by light coat of core- plate vanish or by oxide layer on the surface. The thickness of lamination varies from 0.35mm for a frequency of 50Hz and 0.5mm for a frequency of 25Hz.

15. How does change in frequency affect the operation of a given transformer?

With a change in frequency, iron and copper loss, regulation, efficiency & heating varies so the operation of transformer is highly affected.

16. What is the angle by which no-load current will lag the ideal applied voltage?

In an ideal transformer, there are no copper & core loss i.e. loss free core. The no load current is only magnetizing current therefore the no load current lags behind by angle 90. However the winding possess resistance and leakage reactance and therefore the no load current lags the applied voltage slightly less than 90.

17. List the arrangement of stepped core arrangement in a transformer?

1. To reduce the space effectively
2. To obtain reduced length of mean turn of the winding
3. To reduce I R loss.

18. Why are breathers used in transformers?

Breathers are used to entrap the atmospheric moisture and thereby not allowing it to pass on to the transformer oil. Also to permit the oil inside the tank to expand and contract as its temperature increases and decreases.

19. What is the function of transformer oil in a transformer?

1. It provides good insulation
2. Cooling.

20. Can the voltage regulation goes –ive? If so under what condition?

Yes, if the load has leading PF.

21. Distinguish power transformers & distribution transformers?

Power transformers have very high rating in the order of MVA. They are used in generating and receiving stations. Sophisticated controls are required. Voltage ranges will be very high.

Distribution transformers are used in receiving side. Voltage levels will be medium. Power ranging will be small in order of kVA. Complicated controls are not needed.

22. Name the factors on which hysteresis loss depends?

1. Frequency 2. Volume of the core 3. Maximum flux density

23. Why the open circuit test on a transformer is conducted at rated voltage?

The open circuit on a transformer is conducted at a rated voltage because core loss depends upon the voltage. This open circuit test gives only core loss or iron loss of the transformer.

24. What is the purpose of providing Taps in transformer and where these are provided?

In order to attain the required voltage, taps are provided, normally at high voltages side (low current).

25. What are the necessary tests to determine the equivalent circuit of the transformer?

1. Open circuit test
2. Short circuit test

26. Define efficiency of the transformer?

Transformer efficiency η= (output power/input power) x 100

27. Mention the difference between core and shell type Transformer

In core type, the windings surrounded the core considerably and in shell type the core surround the windings i.e winding is placed inside the core

28. Full load copper loss in a transformer is 1600W. What will be the loss at half load?

If n is the ratio of actual load to full load then copper loss = n2 (F.L copper loss) Pc = (0.5)2 – 1600=400W.

29. Define all day efficiency of a transformer?

It is computed on the basis of energy consumed during a certain period, usually a day of 24 hrs. All day efficiency=output in kWh/input in kWh tor 24 hrs.

30. List the advantage of stepped core arrangement in a transformer?

1. To reduce the space effectively
2. To obtain reduce length of mean turn of the winding
3. To reduce I2R loss.

31. Why are breathers used in transformers?

Breathers are used to entrap the atmospheric moisture and thereby not allowing it to pass on to the transformer oil. Also to permit the oil inside the tank to expand and contract as its temperature increases and decreases.

32. What is the basic purpose (role) of tertiary winding?

1. For an additional load at a voltage different from that of the primary and secondary.

2. To supply phase compensating devices, such as condensers, operated at avoltage which is different from both primary and secondary voltage.
3. As a voltage coil in a cascaded testing transformer.

33. What happens if DC supply is applied to the transformer?

If DC supply is applied to the primary winding of the transformer, it sets up steady magnetic field. Due to production of steady magnetic field , the emf does not include in the secondary winding. The continuous supply of DC, the winding will be heated and insulation of winding may failure.

34. Specify the applications of transformer.

1. Autotransformer in induction and synchronous motors
2. Electrical testing lab
3. As booster to raise the voltage in AC feeders

35. Define all day efficiency of a transformer.

$$All\ day\ efficiency = \frac{output\ in\ KWh}{Input\ in\ KWh}(for\ 24\ hours)$$

36. What is inrush current in a transformer?

Generally inrush current will occur in a transformer at the time of starting. When an transformer is energized from primary side with secondary circuit is open, it acts as an inductor and the transformer draws high magnetizing current from source.

37. Define voltage regulation of a transformer.

It is the arithmetic difference between the no- load secondary voltage and secondary voltage on load expressed as percentage of no- load voltage.

$$\%\ Voltage\ regulation = \frac{E_2 - V_2}{E_2}$$

38. Draw Scott connection of a transformer.

UNIT-3

ELECTROMECHANICAL ENERGY CONVERSION AND CONCEPTS IN ROTATING MACHINES

1. State the principle of electromechanical energy conversion?

The mechanical energy is converted in to electrical energy which takes place through either by magnetic field or electric field

2. Distinguish between statically induced emf and dynamically induced emf?

When emf induced in a conductor is stationary in a magnetic field then we call it statically induced emf.

If emf is induced in a conductor due to relative motion between conductor and the field then it call it as dynamically induced emf.

3. What does speed voltage mean?

It is that voltage generated in that coil, when there exists a relative motion between coil and magnetic field

4. Give example for single and multiple excited systems?

Single excited system-reluctance motor, single phase transformer, relay coil

Multiply excited system-alternator, electro mechanical transducer

5. Why do all practical energy conversion devices make use of the magnetic field as a coupling medium rather than electric field?

When compared to electric field energy can be easily stored and retrieved form a magnetic system with reduced losses comparatively. Hence most all practical energy conversion devices make use of magnetic medium as coupling

6. State necessary condition for production of steady torque by the interaction of stator and rotor field in electric machines?

1. The stator and rotor fields should not have any relative velocity or speed between each other
2. Airgap between stator and rotor should be minimum
3. Reluctance of iron path should be negligible
4. Mutual flux linkages should exist between stator and rotor windings

7. Write the application of single and doubly fed magnetic systems?

Singly excited systems are employed for motion through a limited distance or rotation through a prescribed angle, Whereas multiply excited systems are used where continues energy conversion take place and in ease of transducer where one coil when energized the care of setting up of flux and the other coil when energized produces a proportional signal either electrical or mechanical

8. Explain the following with respect to rotating electrical machines

1. Pole pitch
2. Charding angle

1. Pole pitch is that centre to centre distance between any two consecutive poles in a rotating machine, measured in slots per poles

2. Chording angle is that angle by which the coil span is short of full pitched in electrical degrees

9. Why energy stored in a magnetic material always occur in air gap

In iron core or steel core the saturation and aging effects form hindrance to storage

Built in air gap as reluctance as well permeability is constant, the energy storage takes place linearly without any complexity

Hence energy is stored in air gap in a magnetic medium

10. What is the significance of co energy?

When electrical energy is fed to coil not the whole energy is stored as magnetic energy.

The co energy gives a measure of other energy conversion which takes place in coil then magnetic energy storage.

1. Field energy
2. Coenergy

11. Write the equation which relates rotor speed in electrical and mechanical radians per second?

ώe=ώm(p/2)
ώe=speed in electrical radians per sec ώm=speed in mechanical radians per sec p=no of poles

12. Relate co energy density and magnetic flux density?
Co energy density=wf=∫0λ (I, x) di wf=1/2BH

13. Short advantages of short pitched coil?
1. Harmonics are reduced in induced voltage
2. Saving of copper
3. End connections are shorter

14. What is the significance of winding factor?
Winding factor gives the net reduction in emf induced due to short pitched coil wound in distributed type
Winding factor kw=kpkd
kp= pitch factor
kd= distribution factor
kp= cos(α/2)
kd= sin(mγ/2)/msin(γ/2)

15. What is the necessity to determine the energy density in the design of rotating machines?
Energy density wf=B2/2μ

16. Write the energy balance equation for motor?
Mechanical energy o/p-=electrical energy i/p-increase in field energy
Ff dx=idλ-dWf

17. Write the expression for the mechanical energy output when the armature moves from one position to other with constant coil current?
Let us assume armature moves from position xa to xb for a constant coil current

The mechanical energy is $\Delta Wm = \int_{xa}^{xb} Ffdx = \Delta Wf$

18. Why all practical energy conversion devices make use of the magnetic field as a coupling medium rather than an electric field? (May/ June-2007, 2014, Nov/Dec- 2013, May- 2015)
The force density on a bounding surface of a magnetic field near saturation is the order of 1.02 x10^6 $Nm^{2.}$ In electric field for the field intensity near breakdown, the force density is only 39.8 Nm^2. So practical size electromagnetic device can only be constructed using magnetic field.

19. What is multiple excited system? (Nov/ Dec- 2007, 2011, May/ June- 2013)
The system which is excited by two independent sources are called multiple excited system.
Ex: Electromechanical transducer, continuous energy conversion devices like alternator, synchronous motor.

20. Write the advantage of analyzing energy conversion device into by field energy concept.
The analysis of energy conversion devices by field energy concept is more general and broad based, since it is applicable to all devices possessing rotational, linear, vibrating, translator motions.

Other advantages:

1. It can deal with both steady state and transient analysis of electromechanical energy converter.
2. It gives more physical insight into the operation of all these devices, which is indispensable.
3. The conventional approach can be introduced at any stage, to study the effect of saturation, communication etc…
4. This approach leads physically to the generalized theory os electrical machines.

21. Write the reason for choosing magnetic field for as medium in electromechanical energy conversion.

Most of the electromechanical energy conversion devices are certain magnetic material. Hence, magnetic field is used as medium in electromechanical energy conversion.

22. Why synchronous machine does not produce torque at any other speed?

1. It is not self starting
2. Locking of stator and rotor fields at synchronous speed.

23. What are the requirements of excitation system?

1. Meet specified response criteria
2. It should have good operating flexibility
3. Must be able to prevent damage to itself, generator and its associated equipments.

24. What do mean by SPP? What is its significance?

SPP is known as slot per pole per phase. The number of slots per pole per phase determines how the winding lay out is arranged. It is also disclosing information about the winding factor and its harminics.

25. Write the equation which relates rotor speed in electrical and mechanical radian/sec.

$$\boldsymbol{\theta_{ed} = \frac{P}{2}\theta_{mech}}$$

$$\boldsymbol{\theta_{ed} = Electrical\ degree}$$

$$\boldsymbol{\theta_{mech} = MEchanical\ rad/sec}$$

26. Define co-energy.

The electrical energy given to the coil is stored in the form of magnetic energy is known as co-energy.

$$W_f = \int_0^{\lambda} \lambda di$$

27. What is meant by winding inductance?

Inductance is the property of an electrical conductor by which a change in current through it induces an electromotive force in both conductor itself and in nearby conductors by mutual inductance.

28. What is magnetic saturation?

For obtaining smooth sinusoidal emf waveform, conductors are placed in several slots under single pole. This winding is known as distributed winding.

UNIT-4

DC GENERATORS

1. What is prime mover?
The basic source of mechanical power which drives the armature of the generator is called prime mover.

2. Give the materials used in machine manufacturing?
There are three main materials used in m/c manufacturing they are steel to conduct magnetic flux copper to conduct electric current insulation.

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

4. 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 loss. It is important in determining heating, temperature rise, rating & efficiency of transformers, machines & other A.C run magnetic devices.

5. 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 flux in core. These circulating current do no useful work are known as eddy current and have power loss known as eddy current loss.

6. 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.

7. How will you find the direction of emf using Fleming's right hand rule?
The thumb, forefinger & middle finger of right hand are held so that these fingers are mutually perpendicular to each other, then forefinger-field thumb-motion middle current.

8. How will you find the direction of force produced using Fleming's left hand rule?
The thumb, forefinger & middle finger of left hand are held so that these fingers are mutually perpendicular to each other, then forefinger-field thumb-motion middle- current.

9. Write down the emf equation for d.c.generator?
$E = (\Phi NZ/60)(P/A)$ V.
p--->no of poles
Z--->Total noof conductor
Φ--->flux per pole, N--->speed in rpm.

10. 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.

11. Why commutator is employed in d.c.machines?
Conduct electricity between rotating armature and fixed brushes, convert alternating emf into unidirectional emf (mechanical rectifier).

12. 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.

13. What are the essential parts of a d.c generator?
1. Magnetic frame or yoke 2. Poles 3. Armature 4. Commutator, pole shoes, armature windings, interpoles 5. Brushes, bearings and shaft.

14. Under What circumstances does a dc shunt generator fails to generate?
Absence of residual flux, initial flux setup by field may be opposite in direction to residual flux, shunt field circuit resistance may be higher than its critical field resistance; load circuit resistance may be less than its critical load resistance.

15. Define critical field resistance of dc shunt generator?
Critical field resistance is defined as the resistance of the field circuit which will cause the shunt generator just to build up its emf at a specified field.

16. 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.

17. 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.

18. What are the conditions to be fulfilled by for a dc shunt generator to build back emf?
The generator should have residual flux, the field winding should be connected in such a manner that the flux setup by field in same direction as residual flux, the field resistance should be less than critical field resistance, load circuit resistance should be above critical resistance.

19. Define armature reaction in dc machines?
The interaction between the main flux and armature flux cause disturbance called as armature reaction.

20. What are two unwanted effects of armature reactions?
Cross magnetizing effect & demagnetizing effect.

21. What is the function of carbon brush used in dc generators?
The function of the carbon brush is to collect current from commutator and supply to external load circuit and to load.

22. 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

23. What is the principle of generator?
When the armature conductor cuts the magnetic flux emf is induced in the conductor.

24. What are the functions of bearing and brushes in DC machines?
The function of brushes is to collect current from conductor. Ball bearings are frequently employed for quiet operation. But for heavy duty machines, roller bearings are preferable.

25. What is meant by excitation of a DC machine? What are the methods of excitation?
The process of giving DC voltage to the field winding of DC machine for producing magnetic field is called excitation.
i. Self-excitation
ii. Separately excitation

26. Why does curving the pole face on a DC machine contribute to a smoother DC output voltage from it?
When the pole faces are curved all the conductor always cut the flux at 90 deg and the emf induced are constant at all times. Hence the output becomes smoother.

27. Define commutation.
The process by which the current in the coil is reversed when the conductors are along the brushes axis, that is when the brushes short circuit the coil is called commutation.

28. List the factors involved in the voltage build up of a shunt generator.
1. Residual magnetism
2. Field current
3. Critical field resistance

29. What are the various methods of improving commutation?
1. Resistance commutation
2. EMF commutation

30. Why the external characteristics of a DC shunt generator is more drooping that of the separately excited generator?
Fall in field current with terminal voltage.

31. What are the various methods of decreasing the effect of armature reaction?
1. Chamfering the pole shoes
2. Providing compensating winding
3. Alternating the cross section of poles
4. Introducing saturation

32. The outer frame of a DC machine serves double purpose. What are they?
It provides mechanical support for the poles and acts as a protecting cover for the whole machine. It carries the magnetic flux produced by the poles.

33. What is the function of interpoles?
In modern DC machines commutating poles or interpoles are provided
It improve commutation.
It decrease the effect of armature reaction
It avoids sparking

34. Why is the airgap made as small as possible between the armature and the poles in a DC machine?

In order to reduce the reluctance of the magnetic circuit.

35. Mention an application of a differently compound generator.

Used in arc welding where larger voltage drop is desirable with increase in current.

36. The series field winding has low resistance while the shunt field winding has high resistance. Why?

Since the series field winding carries high load current, it has low resistance. But shunt field winding carries very less current and so it has high resistance.

37. What is the importance of residual emf in a self excited DC generator?

To develop emf in an armature.

38. What is meant by distributed winding?

All the coils belonging to a phase are well distributed over the 'm' slots per phase under every pole.

39. Why fractional pitched winding is preferred over full pitched winding?

1. The length required for end connection of coil is less. So less copper is required.
2. It eliminates high frequency harmonics. Induced emf is more sinusoidal due to short pitching.
3. As high frequency harmonics get eliminated eddy current and hysteresis losses also get minimized and efficiency is improved.

40. Define winding factor.

The fraction by which the resultant emf gets reduced because of distributed winding is indicated by distribution factor.

Winding factor= Distribution factor x pitch factor

$K_w=K_dK_p$

41. What are the causes of sparking at the brushes of DC machines?

1. Due to wear and tear of brushes
2. Due to ageing
3. Due to dust particle

42. What is meant by residual emf in DC generator?

At no load condition or at open circuited condition there will be some amount of emf which is induced in the armature is called residual emf. Because it is induced in the armature conductor due to residual flux present in the field poles.

43. Compare lap and wave winding.

S.No	Lap winding	Wave winding
1	Suitable for high current, low voltage generator	Suitable for high voltage, low current generator
2	Number of parallel paths A=P	Number of parallel paths A=2

44. Draw speed torque characteristics of DC series motor.

UNIT-5
DC MOTORS

1. What is prime mover?

The basic source of mechanical power which drives the armature of the generator is called prime mover.

2. Give the materials used in machine manufacturing?

There are three main materials used in m/c manufacturing they are steel to conduct magnetic flux copper to conduct electric current insulation.

3. What are the types of armature winding?

1. Lap winding, A=P,
2. Wave winding, A=2.

4. How are armatures windings are classified based on placement of coil inside the armature slots?

Single and double layer winding.

5. What are different methods of speed control in D.C shunt motor?

1. Armature control
2. Flux or field control
3. Applied voltage control

6. When is a four point DC starter required in DC motors?

A four point DC starter is required for dc motor under field control

7. If speed is decreased in a dc motor, what happens to the back emf decreases and armature current?

If speed is decreased in a dc motor, the back emf decreases and armature current increases.

8. How does a series motor develop high starting torque?

A dc series motor is always started with some load. Therefore the motor armature current increases. Due to this, series motor develops high starting torque.

9. What is the necessity of starter in dc motors?

When a dc motor is directly switched on, at the time of starting, the motor back emf is zero. Due to this, the armature current is very high. Due to the very high current, the motor gets damaged. To reduce the starting current of the motor a starter is used.

10. Mention the types of braking of dc motor?

1. Regenerative braking
2. Dynamic braking
3. Plugging

11. What are the losses in dc motor?

1. Copper losses
2. Iron losses
3. Mechanical losses

12. Name any 2 non-loading method of testing dc machines?

1. Swinburne's test
2. Hopkinson test

13. 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.

14. What is back emf in d.c. motor?

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 conductor is in opposite to current. As this emf always opposes the flow of current in motor operation it is called as back emf.

15. What is the function of no-voltage release coil in d.c. 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 ON position against spring force. When the supply voltage fails or becomes lower than a prescribed value then electromagnet may not have enough force to retain so handle will come back to OFF position due to spring force automatically.

16. Enumerate the factors on which speed of a d.c.motor depends?

N= (V-IaRa)/Φ so speed depends on voltage applied to armature, flux per pole, resistance of armature.

17. What is the principle of motor?

When a current carrying conductor is placed in a magnetic field it experiences a force tending to move it.

18. 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, chemicals….etc. to protect the motors against these elements, the motor frames are made either partially closed or totally closed or flame proof.

19. Give the applications of DC series motor.

Cranes, hoists, elevators, Trolleys, conveyors, Electric locomotives.

20. Write down the advantages of hopkinson's test.

1. Power required for the test is small as compared to full load powers of the two machines.
2. As machines are being tested under full load conditions, the temperature rise and commutation qualities can be observed.
3. Because of full load conditions, any change in iron loss due to flux distortion at full load is being taken in to account.

21. Why is the starting torque of a DC series motor more than that of the shunt motor of the same power rating?

In series motor, Torque is proportional to the square of armature current.

$T_a \alpha \phi I_a \alpha I_a^2$

In shint motor, Torque is proportional to the armature current.

$$T_a \alpha I_a$$

22. Write the speed equation of a DC motor.

$N \alpha E_b/\phi$

Speed is directly proportional to the back emf and inversely proportional to the flux.

23. State the advantages of swinburn's test.

1. This method is convenient and economical as less power is required for testing even a large motor. i.e. only no load power is to be supplied.
2. The motor is not required to be loaded. i.e. only test to be carried out is the no load test.
3. Since constant losses are known, the efficiency can be estimated at any load.

24. Why is belt drive not suitable for DC series motor?

For belt driven loads, there is possibility of breaking of a belt causing no load condition for the series motor.

But on no load, DC series motor tries to run at dangerously high speed and may get damaged. To avoid such situation, DC series motor is not suitable for belt driven loads.

25. Explain why swinburn's test cannot be performer on DC series motor?

The swinburn's test is a no load test. On no load, DC series motor runs at dangerously high speed and may get damaged. Hence no load condition cannot be achieved on DC series motor for testing purpose. Thus swinburn's test cannot be performed on DC series motor.

26. Why is DC series motor ideally suited for traction application?

It requires high starting torque in order to tackle the load connected. The DC series motor has high starting torque. Hence it is used in all types of traction motors.

27. What are all the disadvantages of swinburn's test?

1. Iron losses are assumed to be constant which is not the true case as they change from no load to full load.
2. No load test only carried out. Hence it is difficult to know whether there will be satisfactory commutation at full load.
3. No load test cannot be performed on a series motor.

28. Specify the techniques used to control the speed of DC shunt motor for below and above the rated speed.

Flux control is used for speed control above rated speed.

Armature voltage control or rheostatic control method is used for below rated speed.

29. What are the reasons for drop in voltage from no load to full load?

1. Due to armature resistance
2. Due to leakage reactance
3. Due to armature reaction

30. Why DC series motor is called as variable speed motor?

Heavy increase in the load should automatically bring about a compensating reductions in speed. So it is called variable speed motor.

31. Specify the technique used to control the speed of DC shunt motor for below and above the rated speed.

1. Armature control method for the speed below rated speed
2. Field control method for the speed above rated speed

32. Why DC series motor is suited for fraction applications?

The torque equation of DC series motor

$$T \alpha \phi I_a$$

$$\phi \alpha I_{se}$$

The torque developed at the starting is very high compared with all other motor. So DC series motor is suited for fraction applications.

33. What is meant by plugging?

Plugging is also called reverse braking. In this method, the shunt armature terminals are reversed to rotate the motor in the reverse direction and the applied voltage V and the back enf Eb starts acting in the same direction. To limit the armature current, a resistance is inserted in series with the armature during reversing the armature.

34. What is meant by plugging?

The DC motor is disconnected from the supply and a braking resistor is connected across the armature. Now the motor works as a generator, producing a braking. This method of braking is called dynamic braking.