UNIT-I
MAGNETIC CIRCUITS AND MAGNETIC MATERIALS

2 MARK QUESTION AND ANSWERS

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

$$H=NI/L$$

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9. Define permeability?

Permeability of a material means its conductivity for magnetic flux. Greater the permeability of material, the greaters 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 densityproduced in air by the same magnetizing force

$$\mu r=\mu/\mu 0$$

11. What is mean 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

$e = Nd\Phi/dt$

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

$$e = Blv\sin\theta$$

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20. What is fringing effect?

It is seen that the useful flux passing across the air gap tends to buldge outwords, there by 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 thicknessincreases

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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

PART B & C QUESTIONS

PART: B

1. A magnetic circuit made of mild steel is arranged as shown in Fig.1. The central limb is wound with 500 turns and has a cross-sectional area of 800 mm^2. Each of the outer limbs has a cross-sectional area of 500 mm^2. The air-gap has a length of 1 mm. Calculate the current required to set up a flux of 1.3 mWb in the central limb assuming no magnetic leakage and fringing. Mild steel required 3800 AT/m to produce flux density of 1.625 T and 850 AT/m to produce flux density of 1.3 T.
2. Explain the similarities and dissimilarities between electric amd magnetic circuits.
3. For the magnetic circuit of fig.2. Various dimensions are also indicated in the fig. when the current flowing through the coil is 2 Ampere, number of turns N is 600 turns, calculate the flux and flux density in the two outer limbs and the central limb. The relative permeability of noncore is infinity.

4. A magnetic circuit of cast steel is arranged as shown in fig.3. Various dimensions are also indicated in the fig. The exciting coil, with N=600 turns, sets up a flux of 1 m Wb in the central limb. Find the coil Current if for cast steel, (a) $\mu r = \infty$ (b) $\mu r = 6000$. Neglect fringing and leakage.
5. Explain the AC operation of a magnetic circuits.

6. A ring composed of three sections. The cross section area is 0.001m2 for each section. The mean arc length are la = 0.3 m, lb,= 0.2m, lc =0.1 m. an air gap length of 0.1 mm is cut in the ring. μr for sections a,, b and c are 5000, 1000 and 10000 respectively. Flux in the air gap is $7.5 \times 10{-}4$ Wb. Find (i) mmf (ii) exciting current if the coil has 100turns (iii) reluctance of the sections.
7. A metal rod wound with 3500 turns is 25 cm long and 2.5cm in diameter. It is bent in to a closed ring and when a current of 0.6A is passed through it, the flux density in it is 0.45Wb/m^2.Assuming that all flux links with every turn of the coil, calculate relative permeability of the metal, self inductance of the coil, emf induced in the coil when the current through the coil is interrupted and the value of flux in iron portion falls to 8 percent of its original value in 0.0015 sec.

8. Define the following: (a) magnetic flux and flux density (b) reluctance (c)permeance (d)mmf (e)magnetic field intensity (f) permeability of free space.
9. (i) Derive an expression for energy density in the magnetic field.

   (ii) Explain in detail " Eddy-current loss".
   (iii) The total core loss of a apecimen of silicon steel is found to be 1500W at 50 Hz. Keeping the flux density constant the loss becomes 3000 W when the frequency is raised to75 Hz. Calculate separately the hysteresis and eddy current loss at each of their frequencies.
10. Define the following terms.
    (i) MMF and Lenz's Law.
    (ii) Faraday's Law of Electro Magnetic Induction.
    (iii) Parallel and series magnetic circuits.
    (iv) Torque and Permeability.

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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?

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

4. What is the purpose of laminating the core in a transformer?

In order to minimise 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.

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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.

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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

To obtain reduced length of mean turn of the winding

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).

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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 transformers?

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 topass on to the transformer oil. Also to permit the oil inside the tank to expand and contract as its temperature increases and decreases

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PART B & C QUESTIONS

1.Explain the principle of operation of a transformer. Draw the vector diagram to represent a load at UPF ,lagging and leading power factor.
2. Obtain the equivalent circuit of a single phase transformer referred to primary and secondary.
3. A single phase transformer has 500turns on the primary and 40 turns on the secondary winding. The mean length of the magnetic path in the iron core is150cm and the joints are equivalent to an air gap of 0.1mm. When a p.d. of 3000v is applied to the primary, maximum flux density is 1.2 Wb/m^2. Calculate the cross sectional area of the core,no load secondary voltage, no load current drawn by the primary, the power factor on no load. Given that AT/cm for a flux density 1.2 tesla in iron to be 5, the corresponding iron loss to be 2 watt/kg at 50 Hz and the density of the iron as7.8 $gram/cm^3$

4. i) Develop an equation for induced emf in a transformer winding in terms of flux and frequency. .
ii) A 230/460V transformer has a primary resistance of 0.2 ohm and reactance of 0.5ohm and the corresponding values for the secondary are 0.75 and 1.8 ohms respectively. Find the secondary terminal voltage when supplying 10A at 0.8 p.f. lagging.
5. The parameters of a 2300/230v, 50Hz transformer are given below: R_1=0.286Ω, R'_2=0.319 Ω, R_0=250 Ω, X_1=0.73 Ω, X'_2=0.73 Ω, X_0=1250 Ω. The secondary load impedance Z_L
6. A 50KVA ,4400/220V transformer has R1=3.45 Ω R2=0.009 Ω. The values of the reactance are x1=5.2 Ω and x2=0.015 Ω. Calculate equivalent resistance as referred to primary, equivalent resistance as referred to secondary, equivalent reactance referred to both primary and secondary, equivalent impedance referred to both primary and secondary, total cu loss first using individual resistances of the two windings and secondly using equivalent resistances as referred to each side =0.387+j0.29. Solve the exact equivalent circuit across the primary.
7. Explain the construction and working principle of a transformer.
8. With neat sketch explain the working of transformer under noload and lagging power factor load.
9. The equivalent circuit referred to the low tension side of a 250/2500 V single phase transformer is shown in fig.4.the load impedance connected to the high voltage terminal is 380 + j230 Ω. For a primary voltage of 250 V, compute, (a) the secondary terminal voltage, (b) primary current and power factor, and (c) power output and efficiency.
10. (i) Derive an expression for maximum efficiency of a transformer.
(ii) A 500KVA transformer has 95% efficiency at full load and also at 60% of full load both at UPF.
a)Separate out the transformer losses.
b) Determine the transformer efficiency at 75% full load, UPF.

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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

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

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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. Derive the relation between co energy and the phase angle between the rotor and stator fluxes of the rotating machines?

F1, f2 are the rotor and stator flux peak values respectively

Fr2=f12+f22+2f1f2cosα

Co energy= { f12+f22+2f1f2cosα}

17. Write the energy balance equation for motor?

Mechanical energy o/p-=electrical energy i/p-increase in field energy

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Ff dx=idλ-dWf

PART B & C QUESTIONS

1. Obtain an expression for the mechanical force of field origin in atypical
Attracted armature relay.
2. Find an expression for the magnetic force developed in a doubly excited magnetic systems.
3. (i) Describe the flow of energy in electromechanical devices.
(ii) Discuss about the 'field energy' and 'coenergy' in magnetic system.
(iii) The magnetic flux density on the surface of an iron face is 1.6 T which is a typical saturation level value for ferromagnetic material. Find the force density on the iron face.
4. Two windings, one mounted on the stator and the other mounted on a rotor have self and mutual inductances of L11=4.5H,L22=2.5Hand L12=2.8cos θ H, where θ is the angle between the axes of the windings. The resistance of the windings may be neglected. Winding 2 is short circuited and the current in winding 1 as a function of time is i1
5. Draw and explain the m.m.f space wave of one phase of distributed a.c. winding. =10 sinωt A. Derive an expression for the numerical value of the instantaneous torque on the rotor in N-m in terms of the angle θ.
6. i) Explain the concept of rotating magnetic field.
ii)Derive the torque equation in round rotor machines.
7. Derive an expression for co-energy density of an electromechanical energy conversion device.
8. The doubly excited magnetic field has coil self- and mutual inductances of L11=L22=2, L21=L12=cosθ , where θ is the angle between the axes of the coils. The coils are connected in parallel to a voltage source V=Vm sinωt . Derive an expression for the instantaneous torque as a function of the angular position θ .Find the time – average torque. Evaluate for θ=30o

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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 currentlosses 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 gives the direction of the lines of flux, thumb gives the direction of the relative motion of conductor and middle finger gives the direction of the emf induced.

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 gives the direction of magnetic field, middle finger gives the direction of the current and thumb gives the direction of the force experienced by the conductor.

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9. 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

10. What are the types of armature winding?

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

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

Single and double layer winding.

12. 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.

13. 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.

14. Why commutator is employed in d.c.machines?

Conduct electricity between rotating armature and fixed brushes, convert alternating emf into unidirectional emf (mechanical rectifier).

15. 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.

16. 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.

17.What are the conditions of parallel operation of DC Generators?

- The Voltages of both the generators must be equal.
- The polarities of the generators must be same or the connections must be interchanged till they become same.

18.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.

PART B & C QUESTIONS

PART :B

1. Derive an expression for the emf of DC generator.

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2. A 6-pole DC generator has 150 slots. Each slots has 8 conductors and each conductor has resistance of 0.01Ω.The armature terminal current is 15 A. Calculate the current per conductor and the drop in armature for Lap and Wave winding connections.

3. Write notes on the following:

(i) Self and separately excited DC generators

(ii) Commutation.

4. Obtain the condition for maximum efficiency of the DC generator.

5. A 400V DC shunt generator has a full load current of 200 A. The resistance of the armature and field windings are 0.06 Ω and 100 Ω respectively. The stray losses are 2000 W. Find the Kw output of prime mover when it is delivering full load and find the load for which the efficiency of the generator is maximum.

6. Explain the different methods of excitation and characteristics of a DC generators with suitable diagrams.

7. Two DC shunt generators are connected in parallel to supply a load of 5000 A. Each machine has an armature resistance of 0.03 Ω and field resistance of 60 Ω but the emf of one machine is 600V and that of the other machine is 640 V. What power does each machine supply?

8. (i) Explain armature reaction and commutation in detail.

(ii) Draw the OCC Characteristics and External Characteristics of DC generator.

9. A 100 kW DC hunt generator driven by a belt from an engine runs at 750 rpm and is connected to 230 V dc mains. When the belt breaks, it continues to run as a motor drawing 9kW from the mains. At what speed would it run? Given: Armature resistance= 0.018 Ω and field resistance=115Ω

10. Draw the performance characteristics of different types of DC generators and explain them.

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UNIT- 5
DC MOTORS

1. Why a dc shunt motor is also called a constant flux motor or constant speed motor?
In shunt motor, flux produced by field winding is directly proportional to the field current i.e. ($\Phi \alpha I_{sh}$). Here, the input voltage is constant and so the flux is also constant. Therefore, DC shunt motor is also called a constant flux motor or constant speed motor.

2. Why series motor cannot be started without any load?
In dc series motor, flux is directly proportional to armature current. i.e. ($\Phi \alpha I_a$). Under no load condition, the armature current is very low and flux also be less. By using the formula $N \alpha (1/\Phi)$, here Φ is less; the motor speed will be very high. Due to this motor will be damaged. Hence dc series motor should always be started with some load on the shaft.

3. What is the function of starters in DC motor?
- To limit the starting current.

- To protect against low voltage and over load condition.

4. List the important parts of a DC starter.
Starting resistance, Handle, over load relay, No voltage relay

5. What are the drawbacks of brake test on DC machines?
- The brake test can be used for small motors only, because in case of large motors, it is difficult to dissipate the large amount of heat generated at the brake.
- This method cannot be used for determining internal losses.
- The output of the motor cannot be measured directly.

6. Name the different types of DC motors.
Shunt motor, Series motor, cumulative compound motor, differential compound Motor.

7. Name any four applications of DC series motors.
Electric traction, Food mixies, Hoist work, Drilling machine

8. Why starters are used for DC motors? Or Why a starter is necessary for a DC motor?
Starters are used in DC motors to limit the 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.

9. How will you change the direction of rotation of a d.c motor?
Either the direction of the main field or the direction of current through the armature conductors is to be reserved.

10. What is back emf in d.c 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 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.

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.List the different methods of speed control of D.C. shunt motor.
- Changing the flux by controlling current through the field winding
- Changing the armature path resistance
- Changing the applied voltage called voltage control method.

13.Specify the techniques used to control the speed of DC shunt motor for below and above rated speed?
For speed control of d.c. shunt motor below rated speed, rheostatic control method is used in which voltage across the armature is controlled. while for the speed control above rated speed, the flux control method is used in which current through field winding is controlled.

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PART B & C QUESTIONS

PART:B

1. Explain the different methods of excitation and characteristics of a DC motors with suitable diagrams.

2. Explain the various methods of controlling the speed of a DC shunt motor and bring out their merits and demerits. Also, state the situations where each method is suitable.

3. (i) Derive from the fundamental, emf and torque equations and explain the characteristics of Dc shunt motor.

(ii) What are the merits and demerits of Hopkinson's test?

4. (i) Discuss in detail about shunt armature speed control of dc shunt motor.

(ii) A 500V dc shunt motor running at 700 rpm takes an armature current of 50A.Its effective armature resistance is 0.4Ω. What resistance must be placed in series with the armature to reduce the speed to 600 rpm, the torque remaining constant?

5. (i) What are the various starting methods of DC motor? Explain any one method.

(ii) Explain in detail the various method of speed control in DC motor?

6. With neat circuit diagram explain the conduction of Swinburne's test.

7. A DC series motor runs at 500 rpm on 220 V supply drawing a current of 50 A. The total resistance of the machine is 0.15Ω, Calculate the value of the extra resistance to be connected in series with the motor circuit that will reduce the speed to 300 rpm. The load torque being then half of the previous to the current.

8. A 250 V dc shunt motor runs at 1000 rpm on no load and takes 5A.The armature and shunt field resistance are 0.2Ω and 250Ω respectively. Calculate the speed when loaded and taking a current of 50A.Due to armature reaction the field weakens by 3%

9. (i)Draw and explain the characteristics of compound motor

(ii)Explain the factor affecting the speed of a DC motor.

10. (i) Explain the important ratings of a DC motor.

(ii) A 250V DC shunt motor has R_f=150Ω and R_a=0.6Ω.The motor operates on no-load with a full field flux at its base speed of 1000 rpm with Ia=50A.If the machine drives a load requiring a torque of 100 Nm, Calculate armature current and speed of motor. If the motor is required to develop 12 kW at 1200 rpm. What is the required value of the external series resistance in the field circuit? Assume linear magnetization. Neglect saturation and armature reaction.

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