QUESTION BANK

Name of the Department : **Electrical and Electronics Engineering**

Subject Code & Name : **EE8301 & Electrical Machines-I**

Year & Semester : **II& III**

UNIT – I MAGNETIC CIRCUITS AND MAGNETIC MATERIALS

PART-A

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/m^2.

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 retentively .

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 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 density produced 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=$k_h b_{max}^{1.62} fv$ watts

Eddy current loss=$k_e b_{max}^2 f^2 t^2 v$ 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 =BlvsinΘ

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.

Squirrel cage IM
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?

Eddy current loss
Hysterisis loss

28. Types of induced emf.

Dynamically induced emf
Statically induced emf

PART-B

1. Explain the methods of analyzing the magnetic circuits
2. Explain the two types of magnetic circuits with neat diagram
3.Explain in detail about electromagnetic induction
4.Draw the typical B-H curve and hysteresis loop and explain its concepts
5.Explain the meaning of self-induced emf, mutually induced emf, statically induced emf, dynamically induced emf and give practical examples.
6. Distinguish between statically induced emf and dynamically induced emf
7. Prove that M=k√L1L2
8. Explain about magnetization curve for Ferro magnetic material
9. Explain in detail about hysteresis loss and eddy current loss in detail
10. Explain various types' core loss on detail

UNIT-2 TRANSFORMERS

PART-A

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 = N_2/ N_1 Transformer = E_2/E_1 = I_1/

I_2 =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 $E_1 = 4.44f\Phi\ mN_1$ volt Emf induced in

secondary Coil $E_2 = 4.44\ f\Phi mN_2$.

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 $= E_2 - V_2/E_2 * 100$ $V_2 > E_2$ for leading p.f load

$V_2 < E_2$ 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?

Frequency
Iron loss

11. What are the typical uses of auto transformer?

To give small boost to a distribution cable to correct for the voltage drop.
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 surrounds 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 90^0 . However the winding possess resistance and leakage reactance and therefore the no load current lags the applied voltage slightly less than 90^0 .

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

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

PART-B

1.Explain the construction of a transformer.

2.a. Derive the emf equation of a transformer.

b. Develop an approximate equivalent circuit for a two winding transformer.

3.A 100 KVA 1100/200v single phase transformer has the following parameters.R1 = 1Ω, X1= 3Ω, R2=0.04Ω, X2=0.012Ω. Find the equivalent resistance and leakage reactance as referred to High Voltage winding.

4.a. Discuss about the working principle of a transformer.

b. Draw the phasor diagram & explain the operation of a practical transformer on load.

5.Draw the equivalent circuit of a single phase 1100/220 V transformer on which the Following results were obtained.

i . 1100V, 0.5A, 55W on primary, secondary being open circuited.

ii. 10V, 80A, 400W on low voltage side, high voltage being short circuited.

Calculate the voltage regulation and efficiency of the above transformer when secondary supply is 100A at 0.8 pf lagging.

UNIT – III ELECTROMECHANICAL ENERGY CONVERSION AND CONCEPTS IN ROTATING MACHINES

PART-A

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.

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

1. Field energy

2. Co energy

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

$\dot{\omega}_e=\dot{\omega}_m(p/2)$

$\dot{\omega}_e$=speed in electrical radians per sec $\dot{\omega}_m$=speed in

mechanical radians per sec p=no of poles

12. Relate co energy density and magnetic flux density?

Co energy density=$w_f = \int_0 \lambda (I, x)\, di$

$w_f=1/2BH$

13. Short advantages of short pitched coil?

1. Hormonics 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 $k_w=k_pk_d$ k_p= pitch factor

k_d= distribution factor $k_p = \cos(\alpha/2)$

$k_d = \sin(m\gamma/2)/m\sin(\gamma/2)$

15. What is the necessity to determine the energy density in the design of rotating machines?

Energy density $w_f = B^2/2\mu$

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

F_1, f_2 are the rotor and stator flux peak values respectively

$F_r^2 = f_1^2 + f_2^2 + 2f_1f_2\cos\alpha$

Co energy= $\frac{\pi\mu_o Dl}{4g}\{f_1^2 + f_2^2 + 2f_1f_2\cos\alpha\}$

17. Write the energy balance equation for motor?

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

$F_f\,dx = i\,d\lambda - dW_f$

18. 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

$$\Delta Wm = \int_{xa}^{xb} Ff\,dx = \Delta Wf$$

PART-B

1. Explain the various concepts of magnetic field in rotating machines
2. Explain with neat diagram the concept of MMF space wave single coil
3. Explain the torque production in synchronous machine
4. Explain the concept of electro mechanical energy conversion in detail
5. Explain the concept of singly excited machine and derive the expression for electromagnetic torque
6. Derive the expression for mechanical force developed by magnetic field
7. Briefly explain the multiply excited magnetic field in detail.
8. Explain in detail the mmf space wave of three phase distributed winding.
9. Derive the torque equation of a round rotor machine clearly stating all the assumption made give the relation between field energy and the mechanical force developed in the field .
10. Derive an expression for co energy in multiply excited magnetic field systems.

UNIT – IV DC GENERATORS

PART-A

1. What is prime mover?

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

2.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.

1. 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.

2. What are factors on which hysteresis loss?

It depends on magnetic flux density, frequency & volume of the material.

3. 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.

4. 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.

5. 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.

6. 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.

7. 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.

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

a. It acts as a protecting cover for the whole machine and provides mechanical support for the poles.

b. It carries magnetic flux produced by the poles

9. What are the types of armature winding?

a. Lap winding,

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

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

Single and double layer winding.

11. 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.

12. 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.

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

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

14. 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.

15. 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.

16. 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.

17. 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.

18. 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.

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

$N = (V - I_a R_a)/\Phi$
so speed depends on voltage applied to armature, flux per pole, resistance of armature.

20. 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.

21. 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.

22. 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.

23. 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.

24. 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.

25. Define armature reaction in dc machines?

The interaction between the main flux and armature flux cause disturbance called as armature reaction.

26. What are two unwanted effects of armature reactions?

Cross magnetizing effect & demagnetizing effect.

27. 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.

28. What is the principle of generator?

When the armature conductor cuts the magnetic flux emf is induced in the conductor.

29. 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.

PART-B

1. Describe with neat diagram the constructional features of DC machines.
2. Derive the expression for generated emf in a DC machine.
3. Discuss the characteristics of DC motors.
4. Derive the torque equation of a DC motor from first principle.
5. What do you mean by losses method & briefly explain it.
6. Discuss in detail the methods of control of speed of a DC motor.

UNIT - V DC MOTORS

PART-A

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so speed depends on air gap flux, resistance of armature, voltage applied to armature.

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The function of the carbon brush is to collect current from commutator and supply to external load circuit and to load.

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

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

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

A four point DC starter is required for dc motor under field control If speed is decreased in a dc motor.

28. 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.

29. 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.

30. 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.

31. Mention the types of braking of dc motor.

1. Regenerative braking 2.Dynamic braking 3.Plugging

32. What are the losses in dc motor?

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

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

1. Swinburne's test 2.Hopkinson test

34. Define armature reaction in dc machines.

The interaction between the main flux and armature flux cause disturbance called as armature reaction.

35. What are two unwanted effects of armature reactions?

Cross magnetizing effect & demagnetizing effect.

36. 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.

PART-B

1. Explain the process of commutation and the methods to improve the commutations.

2. Explain the methods speed control of DC shunt motor.

3. Explain in detail the armature reaction in the DC machines.

4. Explain the methods speed control of DC series motor.

5. Explain the three point starter in detail with diagram .

6. Explain any 2 methods of testing of DC machines .

7. Explain the methods of excitation in DC generators.

8. Explain characteristics of DC generator.