UNIT – I D.C. MACHINES

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. 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 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.

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. 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.

18. 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.

19. 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.

20. 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.

21.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.

22.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

23. 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.

24. 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.

25. 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.

26. Define armature reaction in dc machines?

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

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

28. 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.

29. What is the principle of generator?

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

30. 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.

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

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

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

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

33. 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.

34. 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.

35. 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.

36. Mention the types of braking of dc motor?

1. Regenerative braking
2. Dynamic braking
3. Plugging

37. What are the losses in dc motor?

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

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

1. Swinburne‟s test
2. Hopkinson test

Subject: EC 6352 – Electrical Engineering & Instrumentation

Subject (Topic) – DC Machines

PART-B

① With a neat Sketch, Explain the Construction and Working of DC Motor and explain each parts.

* A Motor is a device which converts an Electrical Energy to Mechanical Energy.

Principle of DC Motor:

* When a Current Carrying Conductor is placed in a magnetic field, it experiences a Mechanical force.

Construction:

Working of DC Motor.

2. What is meant by DC Generator? Explain the theory and principle of operation and working of DC Generator.

* Which Converts Mechanical energy to Electrical Energy

* PARTS of DC Generator.

* Magnetic frame yoke
* Armature.
* Brushes, Bearings and Shaft.
* Poles, inter poles

Circuit diagram:

PARTS:

Principle of operation:

* The emf changes from instant to instant and becomes alternatively positive and negative. Such emf is called alternating emf.

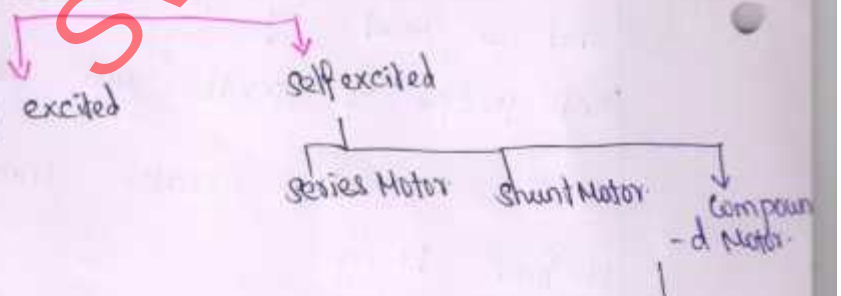
* The induced emf in the coil can be increased by

  * Increasing the flux density (B)
  * " " angular velocity (ω).

(3) Explain various types of DC Motors with suitable dia-gram showing the connections of field coils to armature.

Types of DC Motor:

(i) Separately excited
(ii) Self excited.



Separately excited:

* The field winding and armature are separated.

DC Series Motor:

- field winding is connected in series with armature.

$I_a = I_{se} = I_L$

$V = E_b + I_a (R_a + R_{se})$

$\phi \propto I_{se} \propto I_a$

DC shunt Motor:

* The field winding connected across the armature

* $V = E_b + I_a R_a + V_{brush}$

$\phi \propto I_{sh}$.

DC Compound Motor:

Long shunt Compound Motor.

Short " "

Long shunt Compound Motor.

$I_L = I_{se} + I_{sh}$

$I_{se} = I_a$

$I_L = I_a + I_{sh}$

$I_{sh} = V/R_{sh}$

$V = E_b + I_a (R_a + R_{se}) + V_{brush}$

Short Compound Motor.

$I_L = I_{se}$, $I_L = I_a + I_{sh}$.

$I_L = I_{se} = I_a + I_{sh}$.

$I_{sh} = \dfrac{V - I_L R_{se}}{R_{sh}}$.

(14) Explain the characteristics of DC Motor.

(i) Speed - armature current characteristics

(ii) Torque - armature " "

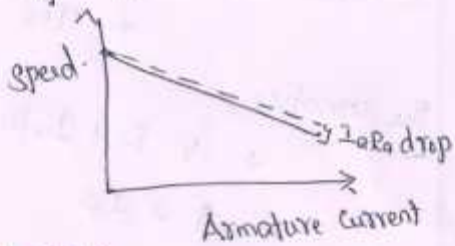
(iii) Speed - torque " "

Shunt Motor:

(i) Speed armature current characteristics:

Speed equation of the DC Motor is

$$N = \frac{K(V - I_a R_a)}{\Phi}$$



(ii) Torque armature characteristics:

$T \propto I_a \Phi$

Φ = Constant

$T \propto I_a$

The dotted line indicated as a shaft torque.

Series Motor:

Speed armature current

$$N = \frac{K(V - I_a R_a)}{\Phi}$$ becomes

$$N = \frac{K(V - I_a R_a)}{I_a}$$

$$N \propto \frac{E_b}{I_a}$$

5. What are the losses in T/F? Derive the condition for maximum η?

* Core iron loss
* Copper loss

Iron (or) Core loss:

Hysterisis loss $\propto K_h B_{max}^{1.6} f$.

Eddy current loss $\propto K_e B_{max}^2 f^2$.

Copper loss:

$(I_1^2 R_1 + I_2^2 R_2)$

Efficiency of a Transformer:

$$\eta = \frac{\text{output power}}{\text{output power + losses}}$$

$$\eta = \frac{n V_2 I_2 \cos\phi}{n V_2 I_2 \cos\phi + P_i + n^2 P_{cu}}$$

(6) Explain with the help of circuit diagram how are (i) η and (ii) Regulation of 1φ T/F predetermined by conducting open circuit and short circuit.

O.C. Test:

No load input power factor $\cos\phi_0 = \frac{W_0}{V_1 I_0}$.

$I_W = I_0 \cos\phi_0$.

$R_0 = \frac{V_1}{I_W}$.

$X_0 = \frac{V_1}{I_\mu}$.

$I_w = I_0 \cos\phi_0$

$I_\mu = I_0 \sin\phi_0$

$I_0 = \sqrt{I_w^2 + I_\mu^2}$

TRANSFORMER ON LOAD:

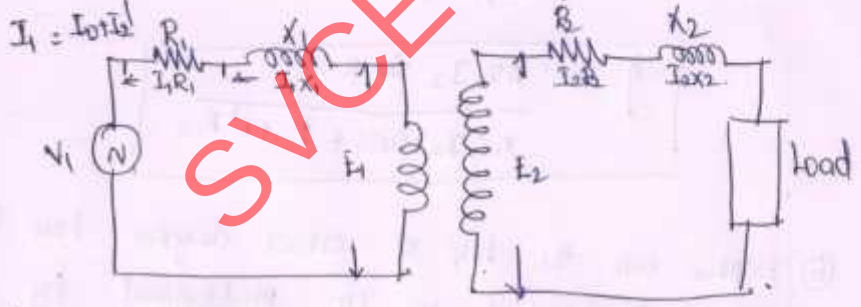
* When the Transformer loaded

* The flux passing through core is same as that at no load (ie) flux is constant on noload

* The total primary current (I_1) will be vector sum of I_0 and I_2'

* Transformer winding resistance

* " " leakage resistance.



$N_1 I_2' = N_2 I_2$

$I_2' = \frac{N_2}{N_1} I_2 = K I_2$

$\bar{I}_2' = -K \bar{I}_2$

$\bar{I}_1 = \bar{I}_2 + \bar{I}_0$

$V_1 = E_1 + I_1 Z_1$

$R_2 = I_2 R_2$

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