K.S.R. COLLEGE OF ENGINEERING, TIRUCHENGODE - 637 215
(Autonomous)

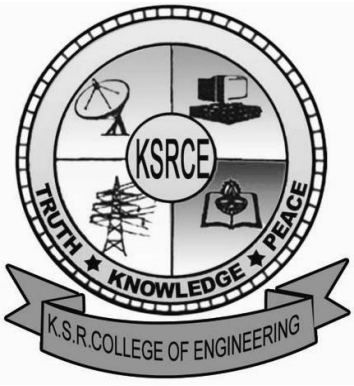
K.S.R. KALVI NAGAR, TIRUCHENGODE - 637 215.

DEPARTMENT ELECTRICAL AND ELECTRONICS ENGINEERING

2 MARKS QUESTION & ANSWER

18EE312 – ELECTRICAL MACHINES - I

2018 REGULATION



UNIT – I

MAGNETIC CIRCUITS(CO1)

1. **Classifications of Electrical Machines.** (Remembering)
   a. Static Machine - Transformer - Single Phase & 3 Phase
   b. Dynamic Machine - AC Machine & DC Machine
      AC Machine - Motor & Alternator
      Motor - Single Phase & 3 Phase
      Alternator - Salient pole & Non-Salient Pole

      DC Machine - Motor & Generator
      Motor - Self Excited
      Series, Shunt & Compound
      Generator - Separately Excited & Self Excited
      Self (Series, Shunt & Compound)
2. **What is Faraday's first law?** (Remembering)
   Whenever the current carrying conductor cuts the magnetic lines of flux an emf will be induced in the coil.
3. **Faradays Second law of Electromagnetic Induction.** (Remembering)
   The amount of emf induced in the coil is directly proportional to the rate of change of flux.
4. **What is fringing effect?** (Remembering)
   While passing through the non magnetic medium the magnetic lines of force try to bulge out because the lines of force repel each other. This opposition of force is known as fringing effect.
5. **State Fleming's left hand rule.** (Remembering)
   Stretch the three fingers in left hand. The thumb, forefinger and middle finger are kept at right angles to each other.
   The **f**orefinger points to the direction of the main **f**ield,
   The **m**iddle or **c**enter finger towards the direction of the **c**urrent in the conductor and
   The thu**m**b gives the direction of **m**otion of the conductor.
6. **State Fleming's right hand rule.** (Remembering)
   Stretch the three fingers in right hand. The thumb, forefinger and middle finger are kept at right angles to each other.
   The **f**orefinger points to the direction of the main **f**ield,
   The **m**iddle or **c**enter finger towards the direction of the **c**urrent in the conductor and
   The thu**m**b gives the direction of **m**otion of the conductor.
7. **What is meant by leakage flux?** (Remembering)
   The flux which takes a path which is not intended for it is called leakage flux..
8. **What is reluctance?** (Remembering)
   It is the property of the magnetic material to oppose the magnetic lines of flux S=F/mmf,
   where F=MMF ; F=flux ;S=reluctance in amp turns per weber
9. **What is a magnetic circuit?** (Remembering)

The circuit which produces the magnetic field is known as magnetic circuit.

10. **List the types of induced emf.** (Remembering)
    - Statically induced emf
        - Self induced emf
        - Mutually induced emf
    - Dynamically induced emf
11. **Define statically induced emf.** (Remembering)
    Conductor remains stationary and flux linked with it is changed.
    (the current which creates the flux changes i.e increases or decreases)

12. **Define Self induced emf.** (Remembering)
    Self-induced EMF is that EMF which is induced in the conductor by changing in its own. When current is changing the magnetic field is also changing around the coil and hence Faraday law is applied here and EMF are induced in the coil to itself which called self induced EMF.
13. **Define Mutually induced emf.** (Remembering)
    When an alternating voltage or current is applied to the coil 'a' alternating current will flow in the coil' a' and is a result of which a varying magnetic field will produced around the coil' a' .if we placed another coil 'b' in the field of coil 'a' then Faraday law is also applied here and EMF are induced in coil `b' this EMF is called mutually induced EMF.
14. **Define dynamically induced emf.** (Remembering)
    Field is stationary and conductors cut across it. Either the coil or the magnet moves.
15. **What is stacking factor?** (Remembering)
    It is the ratio between the net cross sectional area of the core to the cross section occupied by the magnetic material.
16. **State Lenz's law.** (Remembering)
    Any induced e.m.f will circulate a current in such a direction as to oppose the cause producing it. $e = -N \, dF/dt$
17. **What is back emf in d.c motors ?** (Remembering)
    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.
18. **What are types of Electrical machines?** (Remembering)
    - Generators,
    - Motors and
    - Transformers.
19. **What is MMF? Give it's expression.** (Remembering)
    MMF is the work done in moving a unit magnetic pole once around the magnetic circuit.
    MMF=N I ampere turns
    Where ;N=no of turns I =current in amp
20. **Define magnetic field intensity.** (Remembering)
    It is the MMF per unit length.
    Unit-Ampturn/metre.

21. Compare electric and magnetic circuits (understanding)

S.No	Magnetic circuit	Electric circuit
1.	Closed path of magnetic flux	Closed path for electric current
2.	Flux = mmf/reluctance	current=emf/resistance
3.	Reluctance=1/aμ0 μr	Resistance R=?l/a
4.	Magnetic flux density B=f/a	current density J=I/a
5.	MMF drop=f S	Voltage drop= I R
6.	Magnetic field intensity H=N I/l	Electric field intensity E=V/d

22. What is self inductance? (Remembering)

The e.m.f induced in a coil due to change of flux in the same coil is known as self inductance.

23. What is mutual inductance? (Remembering)

When two coils are kept closed together, due to the change in flux in one coil , an emf is induced in the another coil. This is known as Mutual inductance.

24. Define ohm's law? (Remembering)

At constant temperature, the current flowing through the conductor is directly proportional to the potential difference across the conductor. V α I and

V = IR

25. What is coupling coefficient? (Remembering)

k = M/vL1 L2

Coupling coefficient is defined as the ratio of mutual inductance to the square root of the product of two self inductances.

26. Define Torque. (Remembering)

A turning or twisting moment of force through a radius is called torque and the unit is N-m.

27. What is mean by eddy current loss? (Remembering)

A phenomenon caused by the rate of change in an induced magnetic field. The relative motion causes a circulating flow of electrons or current within the conductor, leading to efficiency loss.

28. What is mean by hysteresis loss? (Remembering)

The power loss in a conductive material caused by molecular friction. As an armature rotates, the molecules rub against each other, leading to efficiency loss.

29. What are types of losses? (Remembering)

- Core losses
- Copper loses
- Mechanical losses.

UNIT – II

DC GENERATORS(CO2)

1. **What are the methods of excitation?** (Remembering)

   - Separately exciting method
   - Self exciting method

2. **Classifications of DC Generators.**(understanding)

   Generally dc generators are classified according to the ways of excitation of their fields. There are three methods of excitation.

   i. Field coils excited by permanent magnets – Permanent magnet dc generators
   ii. Field coils excited by some external source – Separately excited dc generators
   iii. Field coils excited by the generator itself – Self excited dc generators

   I. Series Generator
   II. Shunt Generator
   III. Compound Generator
      a. Long Shunt Differential Compound
      b. Long Shunt Cumulative Compound
      c. Short Shunt Differential Compound
      d. Short Shunt Cumulative Compound

3. **Define Air Gap.** (Remembering)

   A small space left between the solenoid core and the armature to break up the magnetic field. Without an air gap, the armature could remain stuck in the closed position even when the solenoid is de-energized.

4. **What is mean by armature?** (Remembering)

   The moveable part of a solenoid that performs work.

5. **Define Coil.** (Remembering)

   Multiple loops of conducting wire used to create a magnetic field when current is passed through it.

6. **What is mean by efficiency loss?** (Remembering)

   Natural effects that cause energy output to be less than energy input. While efficiency losses can be minimized with good design, no system is 100% efficient.

7. **Define Generator.** (Remembering)

   A device that converts mechanical energy into electrical energy by magnetic induction.

8. **Define inductive reactance.** (Remembering)

   The magnetic opposition to current flow in a coil. During inductive reactance, changes in a magnetic field produce a voltage that is counter to the normal direction of current flow.

9. **Define Inrush current.** (Remembering)

   The initial surge of current into a solenoid. Inrush current can be up to ten times higher than the continuously needed current because there is low initial resistance.

10. **Define linear motion.** (Remembering)

    Motion that takes place in a straight line rather than rotating in place around an axis.

11. **Define magnetic induction.** (Remembering)

The use of magnets to cause voltage in a conductor. Magnetic induction occurs whenever a conductor passes through magnetic lines of flux.

12. **Define Polarity.** (Remembering)

Having two oppositely charged poles, one positive and one negative. Polarity determines the direction in which current tends to flow.

13. **Define Specifications.** (Remembering)

A description of the essential physical and technical properties of a machine or device. Specifications or "specs" often include voltage and stroke ratings.

14. **Define Tolerance.** (Remembering)

The acceptable variation from a specified dimension.

15. **Define Transient.** (Remembering)

A short surge of current or voltage, often occurring before steady-state conditions have become established.

16. **Name the basic parts of the DC Generator.** (Remembering)

A DC Generator has the following parts

1) Yoke
2) Pole of Generator
3) field winding
4) Armature of dc generator
5) Brushes of generator
6) Bearing

17. **What is the role of yoke in DC Generator?**(understanding)

Yoke of dc generator serves two purposes,

(i) It holds the magnetic pole cores of the generator and acts as cover of the generator.

(ii) It carries the magnetic field flux.

In small generator, yoke are made of cast iron. Cast iron is cheaper in cost but heavier than steel. But for large **construction of DC generator**, where weight of the machine is concerned, lighter cast steel or rolled steel is preferable for constructing yoke of dc generator. Normally larger yokes are formed by rounding a rectangular steel slab and the edges are welded together at the bottom. Then feet, terminal box and hangers are welded to the outer periphery of the yoke frame.

18. **Define commutator of DC Generator.** (Remembering)

The commutator plays a vital role in dc generator. It collects current from armature and sends it to the load as direct current. It actually takes alternating current from armature and converts it to direct current and then send it to external load.

It is cylindrical structured and is build up of wedge - shaped segments of high conductivity, hard drawn or drop forged copper. Each segment is insulated from the shaft by means of insulated commutator segment shown below. Each commutator segment is connected with corresponding armature conductor through segment riser or lug.

19. **Give emf equation of DC Generator.** (Remembering)

In general generated e.m.f

$$E_g = \frac{\varnothing ZN}{60} \text{ x } (\frac{P}{A}) \text{ volt}$$

where, A = 2 - for simplex wave-winding A = P - for simplex lap-winding

20. **Give DC Generator Ratings.** (Remembering)

A DC generator contains four ratings.

Voltage: Voltage rating of a machine is based on the insulation type and design of the machine.

Current: The current rating is based on the size of the conductor and the amount of heat that can be dissipated in the generator.

Power: The power rating is based on the mechanical limitations of the device that is used to turn the generator and on the thermal limits of conductors, bearings, and other components of the generator.

Speed: Speed rating, at the upper limit, is determined by the speed at which mechanical damage is done to the machine. The lower speed rating is based on the limit for field current (as speed increases, a higher field current is necessary to produce the same voltage).

21. **How can you varying your generator terminal voltage?** (understanding)

DC generator output voltage is dependent on three factors:
(1) the number of conductor loops in series in the armature,
(2) armature speed, and (3) magnetic field strength.
In order to change the generator output, one of these three factors must be varied. The number of conductors in the armature cannot be changed in a normally operating generator, and it is usually impractical to change the speed at which the armature rotates. The strength of the magnetic field, however, can be changed quite easily by varying the current through the field winding. This is the most widely used method for regulating the output voltage of a DC generator.

22. **What is a multiply excited magnetic field system?** (Remembering)

If the electromechanical devices have more than one set of exciting system it is called multiply excited magnetic field system.

23. **How does electromechanical energy conversion occurs?** (Remembering)

It occurs through the medium of the magnetic stored energy.

24. **Why does the energy storage in a magnetic material occurs mainly in the air gap?** (understanding)

The reluctance of the air gap is much larger than the magnetic material . hence the predominant energy storage occurs in the air gap and the properties of the air gap are determined by the dimension of the air gap.

25. **Give the expression for magnetizing force.** (Remembering)

F = B I l sinθ Newton,
Where
I is the current carried by the conductor, l is the effective length of the conductor and
B is the flux density in Wb/m2

26. **Define critical field resistance in dc shunt generator**(Remembering)

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.

27. **What is coupling field?** (Remembering)

Coupling field is the field used to convert electrical energy into mechanical energy.

28. **Write any two advantages of electromechanical energy conversion.**(Remembering)

- Less no of components is used.
- More accurate.

29. **What is quasi static field?** (Remembering)

It is the field pattern which is fixed in space but field intensity at every point varies as a replica of time variation of current.

30. **Define single layer winding & double layer winding.** (Remembering)

The slot consists of only one winding is called single layer winding.
The slot consists of two winding is called double layer winding.

31. **What are the advantages of short pitch coil?**(Remembering)

- Amount of copper requirement is less.
- To reduce the Hysteresis losses is less.

32. **Which type of d.c armature winding requires equalizer rings?** (Remembering)
    Lap winding
33. **How are armature windings classified based on the placement of the coil inside the armature slots?**(Remembering)
    - Single layer winding and
    - Double layer winding
34. **Write any two assumptions in rotating machines to produce torque.** (Remembering)
    - Stator and rotor mmf's are sinusoidal space waves; this is sufficiently ensured by distributed windings.
    - Rotor is cylindrical (non-salient pole) so that the air gap is uniform throughout.
35. **Define slot angle.** (Remembering)
    It is defined as the ratio of the 180degree to the pole pitch.
36. **What is slot pitch?** (Remembering)
    It is the distance between the two coil sides of the same commutator segments.
37. **What is pole pitch?** (Remembering)
    It is the ratio of the total no. of armature coils to the total no of poles.
38. **On what occasions dc generators may not have residual flux?** (understanding)
    - The generator may be put for its first operation after its construction.
    - In previous operation the generator would have been fully demagnetized.
39. **What is distributed windings?** (Remembering)
    Windings which are spread over a number of slots around the air gap periphery.
40. **What is back pitch?** (Remembering)
    It is defined as the distance between two sides of the same coil is expressed in terms o coils sides and denoted by Y_b.
41. **Compare lap & wave windings.** (understanding)

S. No	Lap winding	Wave winding
1	No. of parallel path = No. of Poles	No. of parallel path = 2
2	No. of brushes = No. of poles	No. of brushes = 2

42. **Name the various types of load characteristics.**(Remembering)
    - Magnetization characteristics.
    - No-load characteristics.
43. **Write the conditions for parallel operations.**(Remembering)
    - Voltage rating must be same
    - Speed of the two machines must be equal
    - X/R ratio should be equal
44. **What are the advantages of parallel operation?**(Remembering)
    - Continuity to supply
    - Easy to attend the maintenance work
    - Easy to manage the maximum demand
45. **List the applications of separately excited DC Generators**(Remembering)
    - These types of dc generators are generally more expensive than self-excited dc generators because of their requirement of separate excitation source. Because of that their applications are restricted. They are generally used where the use of self-excited generators are unsatisfactory.
    - Because of their ability of giving wide range of voltage output, they are generally used for testing purpose in the laboratories.
    - Separately excited generators operate in a stable condition with any variation in field excitation. Because of this property they are used as supply source of dc motors, whose speeds are to be controlled for various applications. Example- Ward Leonard Systems of speed control.

46. List the applications of shunt wound DC Generators. (Remembering)

The application of shunt generators is very much restricted for its dropping voltage characteristic. They are used to supply power to the apparatus situated very close to its position. These type of dc generators generally give constant terminal voltage for small distance operation with the help of field regulators from no load to full load.

- They are used for general lighting.
- They are used to charge batteries because they can be made to give constant output voltage.
- They are used for giving the excitation to the alternators.
- They are also used for small power supply.

47. List Applications of series wound DC Generators(Remembering)

These types of generators are restricted for the use of power supply because of their increasing terminal voltage characteristic with the increase in load current from no load to full load. We can clearly see this characteristic from the characteristic curve of series wound generator. They give constant current in the dropping portion of the characteristic curve. For this property they can be used as constant current source and employed for various applications.

- They are used for supplying field excitation current in dc locomotives for regenerative breaking.
- This types of generators are used as boosters to compensate the voltage drop in the feeder in various types of distribution systems such as railway service.
- In series arc lightening this type of generators are mainly used.

48. List Applications of compound wound dc generators(Remembering)

Among various types of dc generators, the compound wound dc generators are most widely used because of its compensating property. We can get desired terminal voltage by compensating the drop due to armature reaction and ohmic drop in the in the line. Such generators have various applications.

- Cumulative compound wound generators are generally used lighting, power supply purpose and for heavy power services because of their constant voltage property. They are mainly made over compounded.
- Cumulative compound wound generators are also used for driving a motor.
- For small distance operation, such as power supply for hotels, offices, homes and lodges, the flat compounded generators are generally used.
- The differential compound wound generators, because of their large demagnetization armature reaction, are used for arc welding where huge voltage drop and constant current is required.

UNIT - III

DC MOTORS(CO3)

1. **What is torque proportional to?** (Remembering)

   Torque is proportional to the interacting fields and to the sine of the electrical space angle between their magnetic axes.

2. **Define chorded coils.** (Remembering)

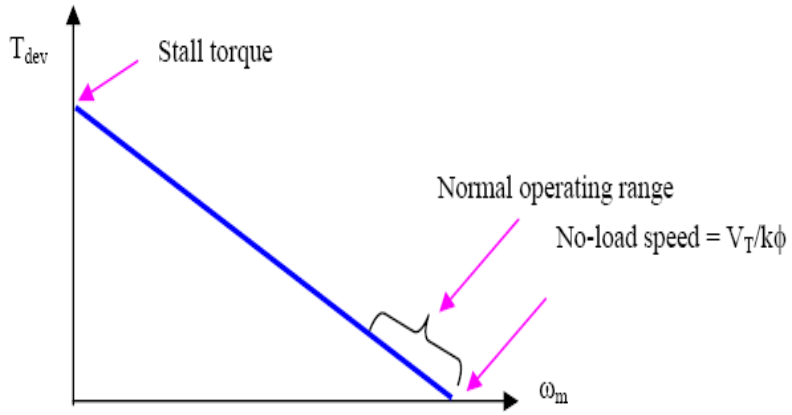
   The coil span is less than full pitched winding by an angle 180 degree.

3. **Why the armature core in d.c machines is constructed with laminated steel sheets instead of solid steel steel?**(understanding)

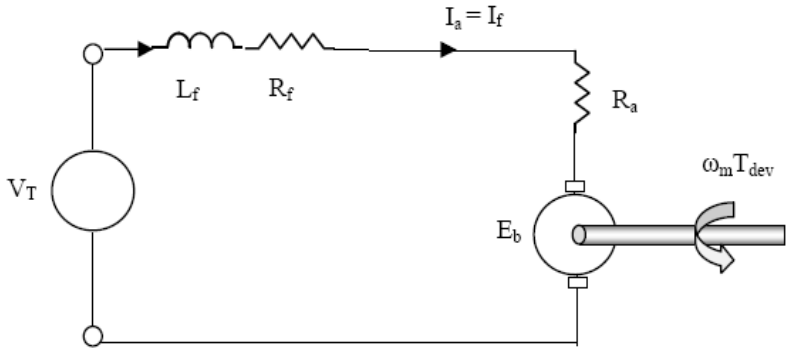
Steel sheets offer low relutance path for the magnetic field , laminated sheets reduce eddy current loss.

4. **What is the function of commutator?** (Remembering)
    - Conduct electricity between armature and fixed brushes
    - Converts altenating emf into unidirectional emf and vice versa
5. **How will you change the direction of rotation of a d.c motor?** (understanding)
   Either the direction of the main field or the direction of current through the armature conductors is to be reserved.
6. **What is back emf in d.c motors ?** (Remembering)
   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.
7. **Define the term armature reaction in dc machines.** (Remembering)
   The interaction between the flux set up by the current carrying armature conductors with the main field flux is defined as armature reaction.
8. **What are the various methods of speed control in dc motor?** (Remembering)
    - Armature control method
    - Field control method
9. **What are the two unwanted effects of armature reaction?** (Remembering)
    - Cross magnetizing effect / Distorting effect
    - Demagnetizing effect
10. **Why are carbon brushes preferred for dc machines?** (understanding)
    The high contact resistance carbon brushes help the current in the coil undergoing commutation to attain its full value in the reverse direction at the end of commutation. The carbon brushes also lubricate and give less wear and tear on commutator surface.
11. **How is the interpole winding in dc machine excited?** (understanding)
    Interpole winding is connected in series with the armature circuit and is excited by the armature current.
12. **What is reactance emf in dc machine?** (Remembering)
    The self induced emf in the coil undergoing commutation which opposes the reversal of current is known as reactance emf.
13. **Name the two methods of improving commutation.** (Remembering)
    - Emf commutation.
    - Resistance commutation.
14. **Differentiate between geometric neutral axis (GNA) and magnetic neutral axis (MNA).** (Remembering)
    GNA is the axis which is situated geometrically or physically in the mid way between adjacent main poles. MNA is the axis which passes through the zero crossing of the resultant magnetic field waveform in the air gap.
15. **Define the term 'critical speed' in dc shunt generator.** (Remembering)
    Critical sped is defined as the speed at which the generator is to be driven to cause self-excited generator to Build up its emf for the given field circuit resistance.

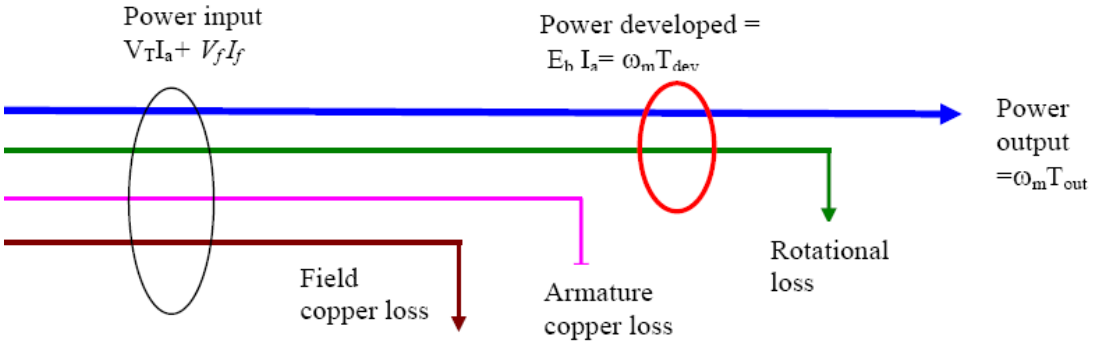
16. **Draw the Torque-speed characteristics of separately excited DC motor** (Remembering)



17. **Draw the equivalent circuit of DC series motor.** (Remembering)



18. **Draw the power flow diagram of DC motor.** (Remembering)



19. **List the typical rating of DC motors.** (Remembering)

Rated voltage: the operating voltage on the input side of the motor

Rated power : Power (in horsepower – hp or watts) that the motor is designed to deliver to the load (i.e., output power) for continuous operation.

Rated speed: Speed (in revolutions per minute, denoted by *r/min* or *rpm*) for which the motor is designed to operate for continuous operation.

Rated load: The load which the motor is designed to carry for (theoretically) infinite period of time. "Full load" or "rated load" operating condition refers to the operation of motor when it is delivering rated power to the load.

20. **What is the necessity of starter.** (understanding)

At starting, when the motor is stationary, there is no back e.m.f. in the armature. Consequently, if the motor is directly switched on to the mains, the armature will draw a heavy current (Ia= V/Ra) because of small armature resistance. In order to limit the high starting current the starters are used.

21. **What are the various types of starters used in dc motor?**(Remembering)

- 2 point starter
- 3point starter
- 4 point starter

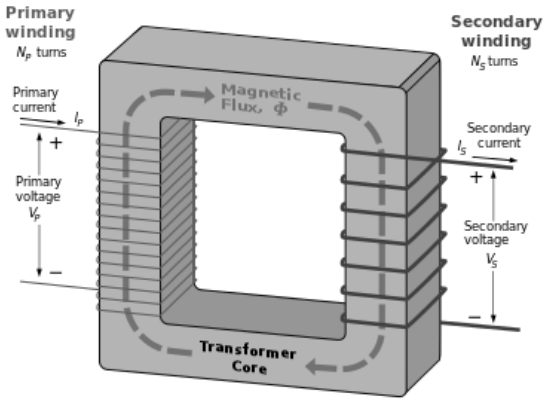
22. **What are the various methods for testing in dc machines?** (Remembering)
    - Direct testing method
    - Indirect testing method
23. **List the methods of improving commutation.** (Remembering)
    There are two main **methods of improving commutation**. These are
    - Resistance Commutation
    - e.m.f. commutation
24. **How can you control the speed of the DC shunt motor?** (understanding)
    The speed of a shunt motor can be changed by
    (i) flux control method
    (ii) armature control method
    (iii) voltage control method.
    The first method (i.e. flux control method) is frequently used because it is simple & inexpensive.
25. **List the Speed control method of DC series motor.** (Remembering)
    The speed control of d.c. series motors can be obtained by
    (i) flux control method
    (ii) armature-resistance control method.
    The latter method is mostly used.
26. **What is mean by braking?** (understanding)
    Sometimes it is desirable to stop a d.c. motor quickly. This may be necessary in case of emergency or to save time if the motor is being used for frequently repeated operations. The motor and its load may be brought to rest by using either (i) mechanical (friction) braking or (ii) electric braking.
27. **Define mechanical braking.** (Remembering)
    Mechanical braking, the motor is stopped due to the friction between the moving parts of the motor and the brake shoe i.e. kinetic energy of the motor is dissipated as heat.
28. **Define electrical braking.** (Remembering)
    In electric braking, the kinetic energy of the moving parts (i.e., motor) is converted into electrical energy which is dissipated in a resistance as heat or alternatively, it is returned to the supply source (Regenerative braking). For d.c. shunt as well as series motors, the following three methods of electric braking are used:
    (i) Rheostatic or Dynamic braking (ii) Plugging (iii) Regenerative braking

UNIT - IV

TRANSFORMERS(CO4)

1. **Define transformer.** (Remembering)
   Transformer is a static electric device. The device is working under the principle of mutual induction and is used to transfers electric energy from one circuit to another circuit through magnetic path without changing its frequency.
2. **State the working principle of transformer?**(understanding)
   Transformer is working under the principle of faradays law of electromagnetic induction. (Mutual Induction Principle)
3. **Mention the difference between core and shell type transformers.** (Remembering)
   In core type , the windings surround the core considerably and in shell type the core surround the winding.
4. **What is the purpose of laminating the core in a transformers?** (Remembering)
   To reduce eddy current loss

5. **List the major components of Transformer.** (Remembering)



- Primary Winding
- Secondary Winding
- Magnetizing Core

6. **Give the emf equation of a transformer and define each term**(Remembering)

   Emf induced in primary coil E1 = 4.44 fF mN1 volt

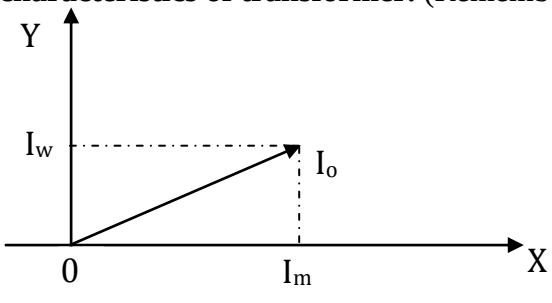
   Emf induced in secondary coil E2 = 4.44fF mN2 volt

   Where; f is the frequency of AC input

   F m is the maximum value of flux in the core

   N1, N2 are the number of primary and secondary turns.

7. **Draw the no-load characteristics of transformer.** (Remembering)



8. **Define voltage regulation of a transformer**(Remembering)

   When a transformer is loaded with a constant primary voltage, the secondary voltage decreases for lagging power factor 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 down = (0V2-V2) x 100/0V2

   % regulation up = (0V2-V2) x 100/V2

9. **Define all day efficiency of a transformer.** (Remembering)

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

10. **Why transformers are rated in kVA ?** (understanding)

    Copper loss of a transformer depends on current and iron loss on voltage . Hence total losses depends on Volt- Ampere and not on the power factor. That is why the rating of transformers are in kVA and not in kW.

11. **What are the typical uses of auto transformer ?** (Remembering)

    - To give small boost to a distribution cable to correct for the voltage drop.
    - As induction motor starters.
    - As furnace transformers
    - As interconnecting transformer

- In control equipment for single phase and 3 phase elective locomotives

12. **How does change in frequency affect the operation of a given transformer ?** (Remembering)

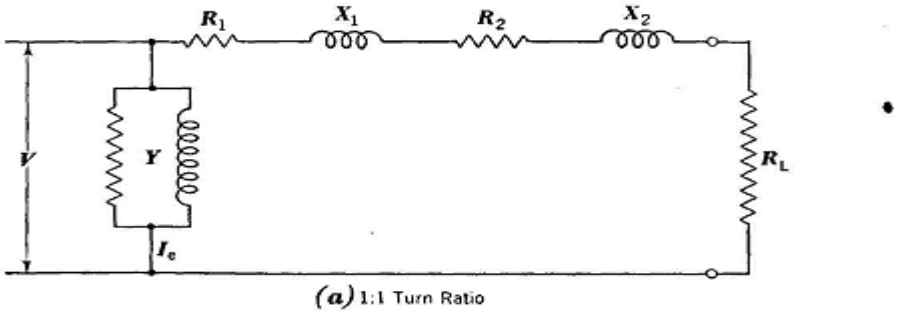
    With a change in frequency, iron loss, copper loss, regulation, efficiency and heating varies and thereby the Operation of the transformer is affected.

13. **What is the function of transformer oil in a transformer ?** (Remembering)

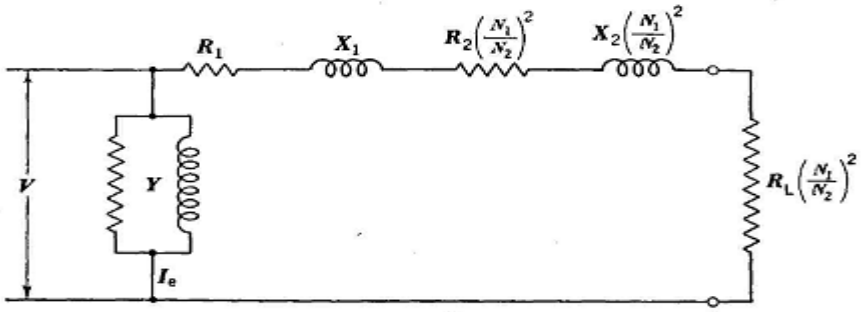
    Nowadays instead of natural mineral oil, synthetic oils known as ASKRELS (trade name) are used. They are noninflammable, under an electric arc do not decompose to produce inflammable gases. PYROCOLOR oil possess high dielectric strength. Hence it can be said that transformer oil provides ,

    (i)good insulation and (ii)cooling .

14. **Draw the equivalent circuit of transformer.** (Remembering)

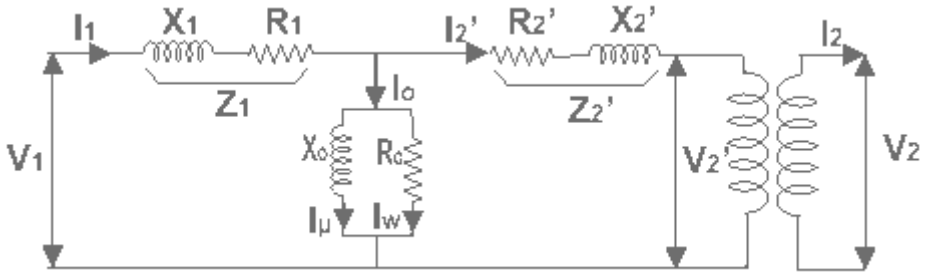


(a) 1:1 Turn Ratio



(b) Any Ratio $\frac{N_1}{N_2} = a$

15. **Draw the equivalent circuit of a transformer referred to primary.** (Remembering)



16. **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 it will be provided at low voltage side.

17. **Why is the efficiency of transformers more than that of other rotating machines?** (Remembering)

    Since the transformer has no rotating part in it, there is no mechanical losses in the transformer. so the transformer has higher efficiency.

18. What are the conditions for parallel operation? (Remembering)

- Frequency of the two transformer must be same
- Phase sequence must be identical
- Voltage rating must be same

19. What are the types of transformer losses. (Remembering)

- Core loss or Constant loss or Voltage loss
- Copper loss or Variable loss or Current loss or I^2R loss

20. What are the classifications of transformer? (Remembering)

Transformers are classified according to their construction as ,

(i)Core type (ii)Shell type (iii)Spirakore type.

Spirakore type is a latest transformer and is used in big transformers.

In "core" type, the windings(primary and secondary)surround the core and in "shell" type, the core surround the windings.

Transformers are classified according to their supply ,

(i) Single phase (ii) Three phase

21. Define Turns Ratio of Transformer(Remembering)

As the voltages in primary and secondary of transformer is directly proportional to number of turns in the respective winding, the transformation ratio of transformer is sometime expressed in ratio of turns and referred as **turns ratio of transformer**

22. Explain the Condition for parallel operation of transformers?(understanding)

The parallel operation of transformers should satisfies the following conditions:

i. Phase sequence ii. Voltage rating iii.Frequency

23. What are the advantages of parallel operation? (Remembering)

- Continuity to supply
- Easy to attend the maintenance work
- Easy to manage the maximum demand

24. What are the different types of connections in transformer?(Remembering)

- Star –star connection
- Star-delta connection
- Delta-delta connection
- Delta-star connection

25. What are the types of cooling in transformers?(Remembering)

- Oil cooling
- Water cooling
- Air cooling

26. Why are breathers used in transformers ?(understanding)

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.Also to avoid sledging of oil i.e. decomposition of oil. Addition of 8 parts of water in 1000000 reduces the insulations quantity of oil. Normally silica gel is filled in the breather having pink colour. This colour will be changed to white due to continuous use, which is an indication of bad silica gel, it is normally heated and reused.

27. What are the functions of no-load current in a transformer ? (understanding)

No-load current produces flux and supplies iron loss and copper loss on no-load.

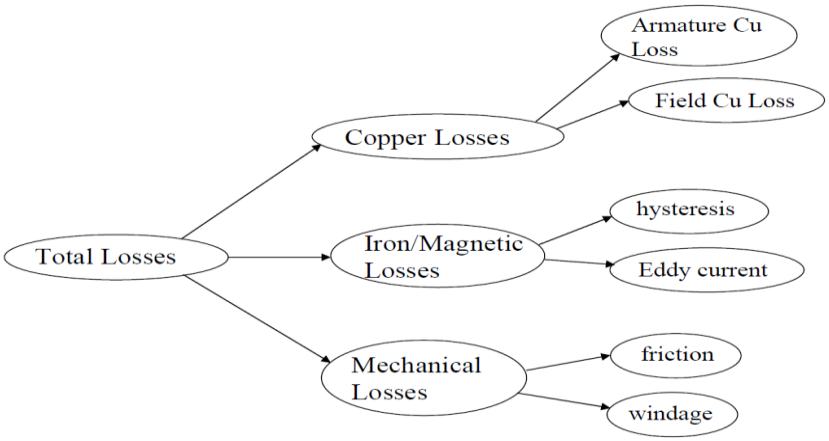
28. When will a Bucholz relay operate in a transformer ? (understanding)

Bucholz rely is a protective device in a transformer. If the temperature of the coil exceeds its limit, Bucholz relay operates and gives an alarm.

UNIT V

TESTING OF DC MACHINES AND TRANSFORMERS(CO5)

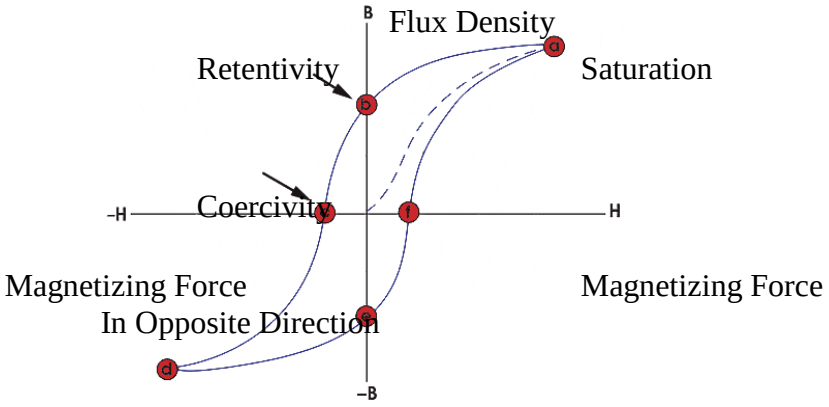
1. **List the classifications of losses in DC Machines.** (Remembering)
   The whole input power is never converted into the output power. The difference between input power and output power is called loss. In a DC Machine losses are classified into five main categories
   - Copper Losses or Electrical Losses
   - Core Losses or Iron Losses
   - Brush Losses
   - Mechanical Losses
   - Stray-Load Losses



2. **Define Copper Losses or Electrical Losses** (Remembering)
   These losses are the winding losses because these occurs in the winding of the machine. The copper or electrical are present because of the resistance of the winding. Currents flowing through these windings produce ohmic losses (i.e. I^2R losses). The windings that may be present addition to Armature winding are the field windings, interpole and compensating windings.

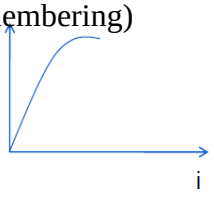
   - Armature current losses = $I_a^2R_a$, where I_a is Armature current and R_a is Armature Resistance.
   - These losses are about 30% of total full-load losses.
   - Copper losses in the shunt field of a shunt machine =$I_{sh}^2R_{sh}$ where I_{sh} is the current in the shunt field and R_{sh} is the resistance of the shunt field winding. The shunt regulating resistance is included in R_{sh}.
   - Copper loss in the series field of a series machine = $I_{se}^2R_{se}$ where I_{se} is the current through the series field winding and R_{se} is the resistance of the series field winding.
   - In a compound machine, both shunt and series field losses occur. There losses are about 20% of full load losses.
   - Copper loss in interpole windings =$I_a^2R_i$ where R_i is resistance of interpole winding.
   - Copper loss in compensating windings =$I_a^2R_c$ where R_c is resistance of compensating winding.

3. **Define Hysteresis Loss** (Remembering)
   - This loss is due to the reversal of magnetism of the armature core.
   - Every portion of the rotating core passes under N and S pole alternately, thereby attaining S and N polarity respectively.



Saturation	Flux Density
In Opposite Direction	In Opposite Direction

4. **What is mean by core loss or iron loss?** (Remembering)
   The sum of eddy current and hysteresis losses is called the *core* loss or *iron* loss. These losses also called magnetic losses. Since DC machines are usually operated at constant speed and constant flux density, these losses are almost constant. These are about 20% of full-load losses.
5. **What is Brush Losses.** (Remembering)
   There is a power loss at the brush contacts between the copper commutator and the carbon brushes. In practice, thin loss depends upon the brush contact voltage drop and the Armature current I_a. It is given by $P_{BD}=V_{BD}I_a$
   The voltage drop across a set of brushes is approximately constant over a large range of Armature currents. Unless stated otherwise, the brush voltage drop is usually assumed to be about 2V. The brush droploss is, therefore, taken as $2I_a$.
6. **What is Mechanical Losses.** (Remembering)
   The losses associated with mechanical effects are called mechanical losses. They consist of bearing friction loss and windage loss. Windage losses are those associated with overcoming are friction between the moving parts of the machine and the air inside the machine for cooling purposes. These losses are usually very small.
7. **Explain about Stray Load- Losses.** (Remembering)
   Stray-load loss consists of all losses not covering above. These are the miscellaneous losses that result from such factors as (i) the distortion of flux because of Armature reaction, (ii) short circuit currents in the coil, undergoing commutation etc. These losses are very difficult to determine. The indeterminate nature of the stray-load loss makes it necessary to assign reasonable value. For most machines stray losses are taken by convention to be 1% of full load output power.
8. **What is the condition for maximum efficiency in DC motor?** (Remembering)
   $I^2R_a = W_c$ (Variable loss = constant loss.)
   The load current corresponding to max efficiency is: $I = \sqrt{\frac{W_c}{R_a}}$



9. **List the Typical tests in DC Machines?** (Remembering)
   - Open Circuit Test & Short Circuit Test
   - Brake Test
   - Swinbunes Test
   - Retardation Test
   - Hopkinsons Test
10. **What is the typical tests in Transformer?** (Remembering)
    - Open Circuit Test & Short Circuit Test
    - Polarity Test
    - Load Test
11. **What is all day efficiency of a transformer?** (Remembering)
    The ordinary efficiency of a transformer is defined as the ratio of the output power to the input power that is;

Efficiency = The Output Power / The Input Power

But, there are certain types of transformers whose performance cannot be judged by this ordinary efficiency.

Suppose a distribution transformers used for providing lighting loads, so the primary of the transformer is energized all the 24 hours in a day but the secondary provide little or no load during the major portion of the day.

The performance of such transformers is judged on the basis of energy consumption during the whole day. This is known as **all day energy efficiency of a transformer**. Basically, the ratio of output in kWh versus the input in kWh of a transformer over a 24-hour period is known as **all day efficiency of transformer**, that is;

All day efficiency = Transformer Output in KWh / Transformer Input in Kwh

Actually, all-day efficiency is very mush useful for those transformers whose primary sides are never open-circuited but the secondary sides carry little or no load much of the time during the day.

Note: Generally, efficiency of a transformer means normal efficiency that is output power/input power unless stated otherwise.

MODEL QUESTION BANK
ELECTRICAL MACHINES I
PART-A

1. What is meant by fringing effect? (Remembering,CO1)
2. Define reluctance. (Remembering,CO1)
3. State Lenz's law. (Remembering,CO1)
4. What is stacking factor? (Remembering,CO1)
5. Write down the emf equation of a transformer? (Remembering,CO2)
6. Draw the no load phasor diagram of transformer? (Remembering,CO2)
7. Write the condition for maximum efficiency of transformer? (Remembering,CO2)
8. List the applications of auto transformer? (Remembering,CO2)
9. Write down the equation for force in magnetic field system? (Remembering,CO3)
10. What is an electro mechanical system? (Remembering,CO3)
11. Describe multiply excited magnetic field system? (Remembering,CO3)
12. Define co energy? (Remembering,CO3)
13. Describe rotating magnetic field. (Remembering,CO4)
14. What is the significance of magnetic leakage in rotating machine?(understanding,CO4)
15. Write down the basic expression for mmf space wave of an single coil rectangular in nature? (understanding,CO4)
16. State the assumptions for peak value of the mmf wave? (Remembering,CO4)
17. State Fleming's left hand rule. (Remembering, CO5)
18. What is the necessity for starters in a dc motor? (Remembering, CO5)
19. What is the function of commutator? (Remembering, CO5)
20. State one method for compensation of armature reaction? (Remembering, CO5)

PART – B

21. a) In a rectangular electromagnetic relay, the exciting coil has 1200 turns. Cross sectional area of the core is A = 6 cm × 6 cm. neglect the reluctance of the magnetic circuit and fringing effects. With coil current kept constant at 2A,derive expression for force on armature as a function of air gap of length x. Find the work done by the magnetic field when x decrease from 1 cm to 0.5 cm by integrating the force. (Applying, CO1)

b) Compare statically induced emf and dynamically induced emf? (understanding CO1)

22. a) Discuss the origin of hysteresis and eddy current losses in electrical machines. (understanding CO1)

b) A straight conductor of 2 m length carries a current of 20A. It is lying at right angles to a uniform magnetic flux density of 0.8 T. Find : (1) the force developed on the conductor (2) the power required to drive the conductor at a uniform speed of 25 m/s and (3) the emf induced in the conductor. (Applying CO1)

23. What are the various losses in a transformer? Derive the equivalent circuit of single phase transformer from its phasor diagram.(remembering,CO2)

24. A 5 KVA 200/1000 V, 50Hz,single phase transformer gave the following test results: O.C test(LV side): 2000 V,1.2A,90W S.C test(HV side): 50 V, 5 A, 110 W (1) Calculate the parameters of the equivalent circuit referred to the LV side. (2) Calculate the output secondary voltage when delivering 3 KW at 0.8 pf lagging, the input primary voltage being 200 V. Find the percentage regulation also. (Applying, CO2)

25. a) Derive the expression for field energy produced in a doubly excited magnetic field system? (understanding, CO3)

b) 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. (Applying, CO3)

26. With necessary diagram discuss about mmf waves of distributed AC winding in detail with equation? .(remembering, CO4)

27. a) The lap wound armature of a 4 – pole generator armature has 51 slots. Each slot contains 20 conductors. What will be the emf generated in machine when driven at 1500 r.p.m. If useful flux per pole is 0.01Wb? (Applying, CO4)

b) A 230 V shunt motor has an armature resistance of 0.3 Ohm and takes an armature current of 40 A on a certain load. By how much must the main flux be reduced to raise speed by 50% and 25% if the developed speed is constant? Neglect saturation and armature reaction. (Applying, CO5)

28. a) Derive the torque equation of a dc machine? (understanding, CO5)

b) A 223 V compound generator is supplying a load of 100 A at 220 V. The resistance of its armature, shunt and series winding are 0.1?,50? and 0.06? repectively. Find the induced emf and thearmature current when the machine is connected in 1) Short shunt 2)Long shunt. (Applying,CO5)

MODEL QUESTION PAPER

B.E./B.Tech. DEGREE EXAMINATION
Electrical and Electronics Engineering
ELECTRICAL MACHINES – I

Time: Three hours **Maximum : 100 marks**

Answer ALL questions.
PART A — (10 x 2 = 20 marks)

1. What is meant by leakage flux? (Remembering,CO1)
2. State Fleming's left hand rule. (Remembering,CO1)
3. Why transformers are rated in kVA instead of kW? (understanding,CO2)
4. Why is the efficiency of transformers more than that of other rotating machines? (understanding,CO2)
5. Mark the co energy region in the graph. (understanding,CO3)
6. What is a multiply excited magnetic field system? (Remembering,CO3)
7. Write the relation between electrical and mechanical degree. (Remembering,CO4)
8. Define distribution factor. (Remembering CO4)
9. What is the function of yoke in a D.C. machine? (Remembering,CO5)
10. Give two reasons for failure of buildup of emf in d.c. shunt generator. (understanding,CO5)

PART B — (5 x 16 = 80 marks)

11. (i) Explain the various methods of commutation. (Remembering,CO1) (16)

Or

(**ii)** With neat sketch, explain the function of 3 point starter. (Remembering,CO1) (16)

12. (a) (i) What is a magnetization curve and why is it used in magnetic circuit calculations? (Remembering,CO2) (8)

(ii) An iron ring of circular cross–section 10 cm2 and mean circumference 30 cm has an air–gap of 2 mm. If the ring is wound with 500 turns, find the exciting current to establish a flux of 0.4 mWb in the air gap. The relative permeability of iron may be assumed to be 2500. (8) (Applying,CO2)

Or

(b) (i) Explain about a.c. operation of magnetic circuits. (Remembering,CO2) (8)

(ii) A straight conductor of 1.5 m length carries a current of 40 A. It is lying at right angles to a uniform magnetic flux density of 0.8 T. Find :(1) the force developed on the conductor (2) the power required to drive the conductor at a uniform speed of 25 m/s and (3) the emf induced in the conductor. (Applying,CO2) (8)

13. (a) (i) What is meant by equivalent circuit of a transformer? What is its use? (8) (understanding,CO3)

(ii) A 600 kVA, single phase transformer when working at u.p.f. has an efficiency of 92% at full load and also at half load. Determine its efficiency when it operates at unity p.f. and 60% of full load. (Applying,CO3) (8)

Or

(b) (i) Explain the back to back method of testing of two identical single phase transformers. (Remembering,CO3) (8)

(ii) State and explain the necessary conditions for parallel operation of two 3 Φ transformers. (Applying,CO3) (8)

14. (a) (i) Explain about energy stored in magnetic system. (understanding,CO4) (8)

(ii) Give a brief note on flow of energy in electromechanical devices. (understanding,CO4) (8)

Or

(b) (i) Derive expression for co energy in a multiply–excited magnetic field system. (8) (understanding,CO4)

(ii) The magnetic flux density on the surface of an iron face is 1.8 T which is a typical saturation level value for ferromagnetic material. Find the force density on the iron face. (8) (Applying,CO4)

15. (a) (i) Explain the constructional features of elementary synchronous machines. (8) (understanding,CO5)

(ii) A 3–phase 440 kVA, 50 Hz, star connected synchronous generator running at 400 rpm is designed to develop 3600 V between terminals. The armature consists of 180 slots, each slot having one coil side with eight conductors. Determine the peak value of the fundamental m.m.f. in AT/pole when the machine is delivering full load current. (Applying,CO5) (8)

Or

(b) (i) Explain about rotating MMF waves in A.C. machines. (remembering,CO5) (8)

(ii) Derive an expression for induced e.m.f. in a synchronous machine. (8) (understanding,CO5)