PREPARATORY NOTE

FOR

QUIZ, TEST & EXAMINATION

PASS WITHOUT TEAR.

COURSE CODE

EEC 233

COURSE TITLE

(ELECTRICAL MACHINES II)

SYNCHRONOUS MACHINE (SYNCHRONOUS MOTOR)

CREDIT UNIT: 3

SACRIFICE AND HARDWORKING SPEAK

AT

LAST IN OUR SCRIPT

BY

HENRY PRECIOUS AMAMINA

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CHAPTER TWO

ENERGY CONVERSION:

This is the process of changing energy from one of its original form into another.

- **Note:**

In practice energy is a quantity that provides the capacity to perform work. In addition to being convertible and also according to the law of conservation of energy.

Energy is transferable to a different location or object but it cannot be created or destroy.

USES OF ENERGY

a. It may be used in natural processes
b. It may be used to provide some services to the society such as:
   i. Heating refrigeration
   ii. Lighting
c. It may used for performing mechanical work to operate machines.

- **Note:**

Kinetic energy corresponding to its increase in speed.

ELECTROMECHANICAL ENERGY CONVERSION:

It means either the conversion of electric energy into mechanical or vice versa for, an example.

TYPE OF ENERGY STORED

There are many different type of energy stored in materials and it takes a particular type of reaction to release each type of energy. In order of the typical magnitude of the energy released, these type of reaction are:

a. **Nuclear reaction**
b. **Chemical reaction**
c. **Electromechanical reaction**
d. **Electrical reaction**

- **Nuclear reaction**: they are used by stars and nuclear power plant. Both of which derive energy from the building energy of nuclei

- **Chemical reaction:** this used by animal to derive energy from food and by automobile to derive energy from gasoline.

- **Electromechanical reaction:** these are used by most mobile device such as laptop computers and mobile phone to release the energy from batteries.

DIFFERENTIAL FORM (DIFFERENTIAL INDUCTION MACHINE)

Differential induction machine is a special type of induction machine having two shaft protected from the two ends of a single stator.

- **Faradays Lenz law:** Faraday experiments showed that the emf induced by a change in magnetic flux depends on only a few factors.

1st law: emf is directly proportional to the change in flux **ΔΦ**

2nd law: emf is greatest when the change in time Δt is smallest – that is, emf is inversely proportional to **Δt.**

- **Note:**

Finally if a coil has N – turn, an emf will be produced that is N – tunes greater than for a single coil, so that emf is directly proportional to N, the equation for the emf induced by a change in magnetic flux is

Emf = - NΔΦ/Δt

This relationship is know as faraday law of induction.

The unit being in volt

- ✓ The minus sign in faraday law of induction is very important.
- ✓ The minus means that the emf creates a current I and magnetic field β that oppose the change in flux ΔΦ that is known as Lenz law.

- **Note:**

(The direction given by the minus sign) of the emf is so important that it is called Lenz law (1809 + _ 1865)

Faraday was well aware of the direction but Lenz stated it so clearly that he is credited for its discovery

- **MAXWELL STRESS:** This is symmetric second order tensor used in classical electromagnetism to represent the interaction between electromagnetic forces and mechanical momentum.

φ_m = maximum flux in the core (in weber) = $B_m * A$

F = frequency of a.c input in H_z

- **Note:**
  From the fig the core flux increase from its zero value to maximum value φ_m in one quarter of the cycle is in ¼

  Average rate of change of flux
  $=\varphi_{m/1/4f} = 4f\varphi_m$wb/s.

  Now rate of change of flux per turn means induced emf in volts
  Average emf induced / turns $4f\varphi_m$volt.

  If flux φ varies sinusoid ally then rms value of induced emf is obtained by multiplying the average value with form factors.

  Form factor= rms/average value= 1.11
  Therefore rms value of emf/turn = 1.11 * $4f\varphi_m$= $4.44f\varphi_m$volts.
  = $4.44f\varphi_m$ volt.

  Also rms value of induced emf in secondary is E_2 = $4.44fN_2\varphi_m = 4.44fN_2\beta mA$
  In an idea transformer not load $V_1=E_1$ and $V_2 = E_2$,
  Where
  V_2= terminal voltage

  Example:

  Question:

  The no load ratio of a 50Hz single phase transformer is 6000/250v. Estimate the number of turns in each winding, if the maximum flux is 0.06wb in the core.

- **Note:**

The later offers an additional advantage of permitting visual inspection of coil in the case of fault and ease of repair at substation site.

For these reason the present practice is to used core type transformer in large high voltage installation.

➢ EQUIVALENT CCT OF A TRANSFORMER:

This is a device that helps in determining the behavior of various operating condition of transformer.

➢ ELECTROMAGNETIC:

This devices consist of a combination of resistances inductances, capacitances, voltages such an equivalent circuit (circuit model) can be analyzed easily by direct application of electric theory

- **Note:**

Equivalent circuit is simply a circuit representation of the equations describing the performance of a transformer

Equivalent circuit of a transformer having transformation ratio K = E_2/E_1 is shown below.

- **Note:**

The induced emf in primary winding E_1 is applied (primary voltage V_1 less primary voltage drop).

This voltage causes iron loss current I_o and magnetizing current I_m and we can therefore, represent these two component of no – load current by the current drawn by a non – inductive resistance R_o and pure reactance X_o having the voltage, or (V_1- primary voltage drop applied across then as shown in fig above secondary current $I_2 = I_1/k = I_1 - I_2/k$

Terminal voltage V_2 across load is induced emf f_2 in secondary winding less voltage drop in secondary winding