



# **Coursework Report**

## **MTCM3011 Electrical Engineering Principles 1**

Aeronautical Engineering  
Marine Engineering  
Systems Engineering

**Military Technological College**

|                                                       |                          |                                                                                   |                                                                  |     |
|-------------------------------------------------------|--------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------|-----|
| <b>Military Technological College</b>                 |                          |  | <b>Assignment/Coursework:</b><br>Individual report (2000 words). |     |
|                                                       |                          |                                                                                   | Covering practical exercises<br>( LOs 1,2,6 and 7)               |     |
| <b>Department:</b> Marine Engineering Department      |                          |                                                                                   |                                                                  |     |
| <b>MTCM3011</b> – Electrical Engineering Principles 1 |                          | <b>Date Set:</b><br>24/10/2017                                                    | <b>Lecturer:</b>                                                 | TBD |
| <b>Artefact:</b> 1 of 2                               | <b>Contribution:</b> 30% | <b>Date Due:</b><br>04/01/2018                                                    | <b>Student number:</b>                                           | TBD |

|                                                                                                 |
|-------------------------------------------------------------------------------------------------|
| <b>Assessment Strategy</b>                                                                      |
| The students will be assessed for LOs [1,2,6 and 7] through an individual report of 2000 words. |

| Item | Assessment                        | Weighting | Assessment Type     | Final Artefact | Pass Mark | Description                 |
|------|-----------------------------------|-----------|---------------------|----------------|-----------|-----------------------------|
| 1    | Individual Report<br>(2000 words) | 30%       | Written assignment, | No             | 40%       | Report on LOs [1,2,6 and 7] |

|                                            |                                                                                                                                                                                                                                                                                                                                     |
|--------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Learning Outcomes (1, 2, 6 &amp; 7)</b> |                                                                                                                                                                                                                                                                                                                                     |
| 1                                          | Describe the basic structure of the atom and explain the significance of the nucleus, protons, neutrons and electrons in the context of electricity and the movement of electrical charges within conductor and insulator materials and explain how electrical energy is generated by light, heat, friction, pressure and movement. |
| 2                                          | Describe the construction and provide simple explanations of the chemical reaction of various primary and secondary cells and batteries in general use and conduct associated measurements and calculations.                                                                                                                        |
| 6                                          | Explain the characteristics of natural magnets, magnetic and non-magnetic materials and magnetic fields, the phenomenon of electromagnetism, and factors determining electric field strength and direction.                                                                                                                         |
| 7                                          | Sketch the construction and explain its theory of operation of DC generators and motors.                                                                                                                                                                                                                                            |

#### Hand in:

- Submit your assignment on or before XXXXXX through Turnitin link on Moodle.

#### Objectives:

- To develop understanding of theoretical knowledge gained during the course of lectures by the use of explanation of questions, calculations and laboratory experiments in the fields of Electrical Engineering.

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#### **Task:**

To produce a report of 2000 words, based on theory studied during the class lectures and laboratory tasks covering the following contents in order to fulfil the prescribed learning outcomes;

- Atoms
- Movement of electrical charge
- Conductors
- Batteries and its construction
- Magnets
- Motors
- Generators

#### **Background:**

- The students have developed basic understanding of Electrical Engineering Principles for DC circuits and calculations. Students have carried out various laboratory tasks on FESTO Equipment. This Laboratory report is required to be comprehensively comprised of all laboratory tasks coupled with theoretical knowledge covered throughout the course of studies.

#### **Equipment/Simulation Tools:**

- FESTO Motor and Generator manual

#### **Procedure:**

- Class Lectures
- FESTO manual

#### **Learning outcomes:**

On successful completion of this assignment, students will be expected, at threshold level, be able to:

1. Explain about the atoms and its structures.
2. Discuss the movements of electrical charge and conductors
3. Describe the principles of operation and the construction of batteries
4. Describe the principles of operation and the construction of DC Motors and Generators

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**Reading / References:**

The Module Course books, Reference Books and Manuals of FESTO Laboratory Equipment.



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Student Id: \_\_\_\_\_1604053

Department:

\_\_\_\_marine\_\_\_\_\_



Marks: \_\_\_\_ /100

# Assignment and LAB Report

**MTCM 3011 – Electrical; Engineering Principles 1**

**Aeronautical Engineering Department**

**Marine Engineering Department**

**Systems Engineering Department**

**Only This document to be  
submitted on Moodle, Please.**

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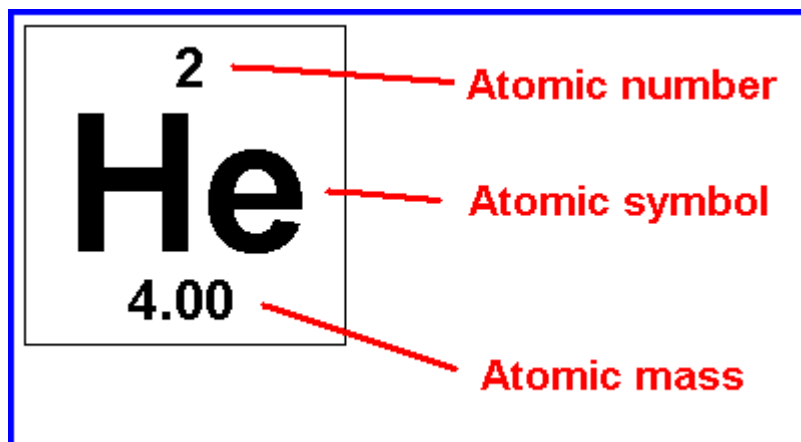
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|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|------------------------------------------------------------------|------------------------|
| <b>Military Technological College</b><br><br><br><br><b>Department:</b> Aero, Marine & Systems Engineering |                          | <b>Assignment/Coursework:</b><br>Individual report (2000 words). |                        |
|                                                                                                                                                                                             |                          | Covering practical exercises<br>( LOs 1,2,6 and 7)               |                        |
| <b>MTCM3011</b> – Electrical Engineering Principles 1                                                                                                                                       |                          | <b>Date Set:</b><br>24/10/2017                                   | <b>Lecturer:</b>       |
| <b>Artefact:</b> 1 of 2                                                                                                                                                                     | <b>Contribution:</b> 10% | <b>Date Due:</b><br>04/01/2018                                   | <b>Student number:</b> |

#### Task 1:

Answer the following Questions

1. Explain what is meant by the following terms:

- Atomic Number: is the quantity of protons found in the core of an nucleus



In this case the quantity of protons in this component is 2. As we known protons have positive charge in the core of an nucleus

- Atomic Mass: is the amount of protons and neutrons in the molecule.

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### 2. How does the lightening form, as an example of ESD:

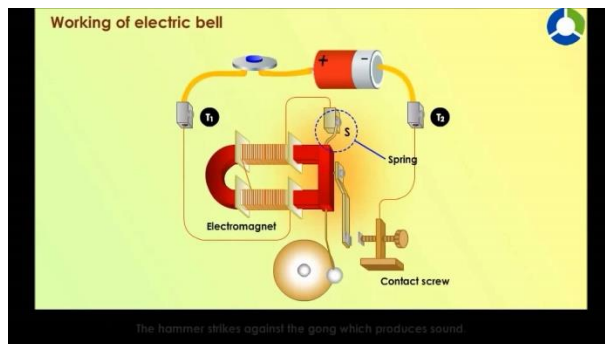
Is a current that move by high density to long distance. Lightning might be produced by storms or some time by volcanoes, but the most common reason is the thunderclouds. Moreover the most kind of lightning discharge that happen on clouds. Also it happening when the electrons (Negi charge) in the minimal of the cloud are attracted to the protons (posit charge) in the ground. When the connection is made, the protons rise up to connect with the electrons who was in the minimal part of clouds. It is at that point that we see lightning. A bolt of lightning warm up the air along her way that causing it to expand rapidly and Thunder is the sound happening by rapidly extending air.

### 3. Distinguish between Natural and Artificial Magnets

Natural magnets are magnets that occur in nature and never lose their magnetic power. First found in a province in Asia called Magnetic, these black rocks were first called “lodestone,” and “magnetite also this rock is very shine when polish. While the artificial magnets is created by people and these magnets can also be magnetized with their north and south poles in a lot of different configurations to suit specific applications.

### 4. Draw and explain the operating principle of simple bell circuit

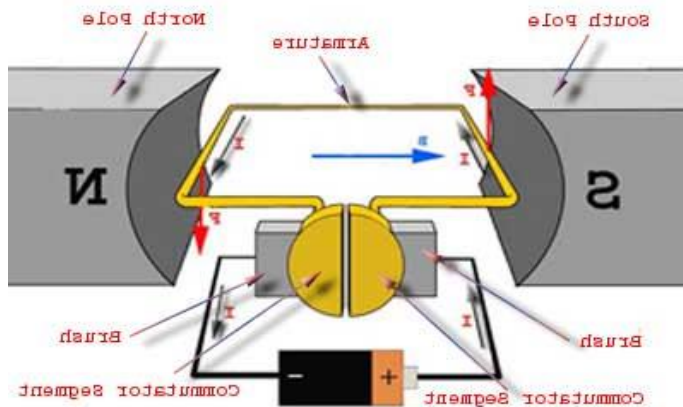
Electric current flows through the coil when the switch is ON, and the iron core acts as an electromagnet. The iron core attracts the hammer towards it. The hammer strikes the bell and produces a sound. The circuit breaks at the screw contact when the hammer moves towards the iron core. At this point, the iron core ceases to be an electromagnet. The hammer is pulled back to its original position due to the spring action of the steel rod, and then touches the contact again to complete the circuit. The circuit is completed and current flux out of the coil again, and the hammer hits the bell again. The process repeats itself and you hear a ringing sound since the hammer keeps hitting the bell, until the switch is released.





5. Draw and Explain the DC motor working principles

The armature is contact to a direct current power source out of same of commutator rings. When the current flux through the coil an electromagnetic force is induced on it according to the Lorentz law, so the coil will start to rotate. The force come from the electromagnetic induction. The commutator rings contact with the power source of Reverse polar.as an outcome on the left direction of the coil the electricity will always flux “away” and on the right direction electricity will always flux ”towards”. This ensures that the torque action is also in the same direction everywhere the motion, so the coil will continue the rotation.



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|                                                        |                          |                                                                                   |                                                                  |  |
|--------------------------------------------------------|--------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------|--|
| <b>Military Technological College</b>                  |                          |  | <b>Assignment/Coursework:</b><br>Individual report (2000 words). |  |
| <b>Department:</b> Marine & Systems Engineering        |                          |                                                                                   | Covering practical exercises<br>( LOs 1,2,6 and 7)               |  |
| <b>MTCM 3011</b> – Electrical Engineering Principles 1 |                          | <b>Date Set:</b><br>24/10/2017                                                    | <b>Lecturer:</b>                                                 |  |
| <b>Artefact:</b> 1 of 2                                | <b>Contribution:</b> 20% | <b>Date Due:</b><br>04/01/2018                                                    | <b>Student number:</b>                                           |  |

**Task 2:** Write a report on Laboratory Tasks performed during Labs by the teaching staff covering following keys areas of DC Motors and Generators;



## The Direct Current Motor – Part I

### Introduction:

A DC motor is a device which it transform electrical energy into mechanical energy. So it is of huge importance for the industry field these days. Applications of direct current motor are repair speed applications such as cars windscreen wipers and fans, Used in industrial appliances such as hair drier and Elevators, rolling mills and other loads which they requiring large momentary torques

Finally, the main component of dc motor which are: Field windings: are the constant winding or magnets. An armature: is revolving section on dc motor. A commutator: is a circulator which made of segments that are isolated from one to others. Brushes: is the slip connect that contra the commutator which made from a carbon and graphite material.

### Discussion:

Motors work on the principle which they when a current carrying- conductor is put in a magnetic field. A force which tends to transfer the conductor outside of the magnetic field. The rubric of this force is given by Fleming's left hand run and its size is given by  $F = BIL$ . Where, B = attractive motion thickness, I = current and L = length of the conductor inside the attractive field. And the armature windings are correlating with a DC supply, current sets up in the winding. Attractive field may be given by field winding or by utilizing lasting magnets. There four main types of dc motor which is: 1-DC series motor: the field is contact in series with the armature. The field is wound with a little of turns of big wire because it should carry the whole armature present day. 2-DC shunt motor: the field is contact in parallel with the armature windings, the shunt-linked motor gives properly speed law. 3-DC compound motor: Compound automobiles have an area contact in series with the armature and a one after the other excited shunt area. The collection field presents better beginning torque and the shunt field gives better speed law. 4-DC permanent magnet motor.

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G 1. Examine the construction of the DC Motor/Generator paying particular attention to the motor, rheostat, connection terminals and wiring. Note that the motor housing has been designed to allow you to view the internal construction. Most commercial motors do not have this open construction.

G 2. Viewing the motor from the rear of the module:

- a. Identify the armature winding.
- b. Identify the stator poles.
- c. How many stator poles are there?

4poles\_\_\_\_\_

- d. The shunt field winding on each stator pole is composed of many turns of small diameter wire. Identify the shunt field winding.
- e. The series field winding, wound inside the shunt field winding on each stator pole, is composed of fewer turns of larger diameter wire. Identify the series field winding.

G 3. Viewing the motor from the front of the module:

- a. Identify the commutator.
- b. Approximately how many commutator bars (segments) are there?

75 commuator bars\_\_\_\_\_

- c. How many brushes are there?

2 brushes\_\_\_\_\_

- d. The neutral position of the brushes is indicated by a red line marked on the motor housing. Identify it.
- e. The brushes can be positioned on the commutator by moving the brush adjustment lever to the right or the left of the red indicator

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line. Move the lever both ways and then return it to the neutral position.

G 4. Viewing the front face of the module:

- a. The shunt field winding (many turns of fine wire) is connected to terminals 5 and 6.
- b. The series field winding (fewer turns of heavier wire) is connected to terminals 3 and 4.
- c. The current rating for each winding is marked on the face of the module.  
Can you answer (a) and (b) having only this information? Explain.

G ☒ Yes ☐ No

The higher current winding utilizes the thicker wire

---

- d. The brushes (commutator segments and armature winding) are connected to terminals 1 and 2.

G 5. The rheostat, mounted on the module face, is designed to control (and safely carry) the shunt field current.

- a. It is connected to terminals 7 and 8.
- b. What is its rated resistance value?

$R_{\text{(field rheostat)}}$  1000  $\Omega$

G 6. You will now measure the resistance of each of the motor windings using the voltmeter-ammeter method. With this information you will calculate the power losses for each of the windings. Using your Power Supply, DC Voltmeter/Ammeter and DC Motor/Generator, connect the circuit shown in Figure 2-1.

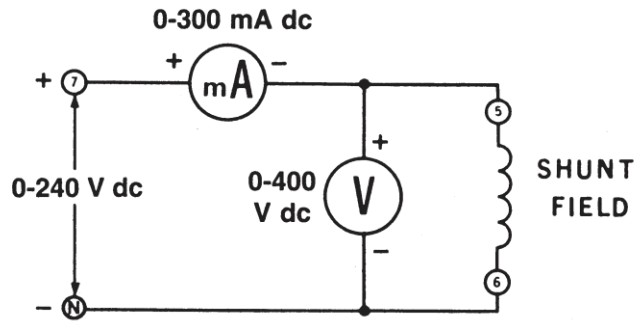


Figure 2-1.

G 7. Turn on the power supply.

- a. Slowly increase the DC voltage until the shunt field winding is carrying 0.3 A of current as indicated by the 0-0.3 A dc meter (this is the nominal current value for the shunt field winding).
- b. Measure and record the voltage across the shunt field winding.

$$E_{\text{(shunt field)}} = \underline{215} \text{ V dc}$$

There are a quantity of variables involved in this and following calculations; therefore, you can expect students to come up with the values within 10% of those shown

- c. Return the voltage to zero and turn off the power supply.
- d. Calculate the resistance of the shunt field winding.

$$R_{\text{(shunt field)}} = E/I = \underline{215} / \underline{0.3} = \underline{716.6} \, \Omega$$

- e. Calculate the  $I^2R$  (power) losses of the shunt field winding.

$$P_{\text{(shunt field)}} = I^2R = \underline{0.09} \times \underline{716.6} = \underline{64.5} \text{ W}$$

G 8. Connect the circuit shown in Figure 2-2.

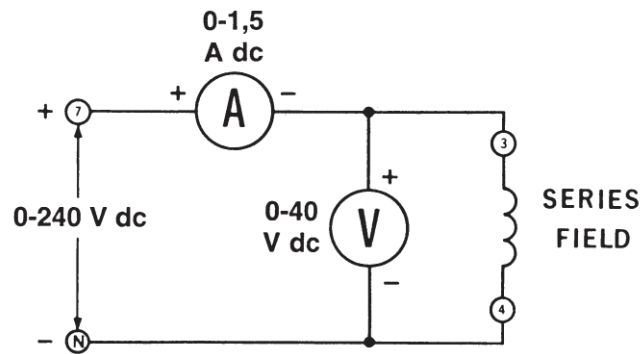


Figure 2-2.

- a. This is the same circuit as shown in Figure 2-1 except that the series field winding has replaced the shunt field winding and that the 1.5A dc meter has replaced the 0-3A dc meter.
- b. Turn on the power supply. Slowly increase the DC voltage until the series field winding is carrying 1.5A of current as indicated by the 1.5A dc meter, (this is the nominal current value for the series field winding). **Warning! This only requires a few volts so advance the voltage control slowly.**
- c. Measure and record the voltage across the series field winding.

$$E_{\text{(series field)}} = \underline{9} \text{ V dc}$$

- d. Return the voltage to zero and turn off the power supply.
- e. Calculate the resistance of the series field winding.

$$R_{\text{(series field)}} = E/I = \underline{9} / \underline{1.5} = \underline{6} \text{ } \Omega$$

- f. Calculate the  $I^2R$  losses of the series field winding.

$$P_{\text{(series field)}} = I^2R = \underline{2.25} \times \underline{6} = \underline{13.5} \text{ W}$$



G 9. Connect the circuit shown in Figure 2-3.

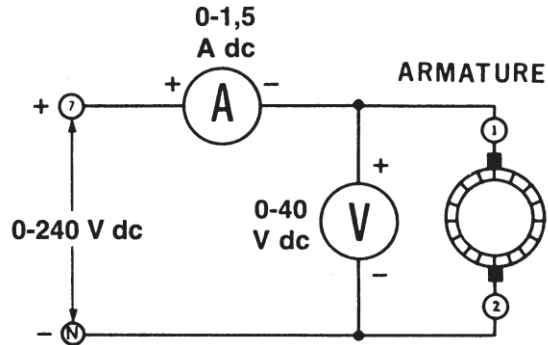


Figure 2-3.

- a. This is the same circuit shown in Figure 2-2 except that the armature winding (plus the brushes) has replaced the series field winding.
- b. Turn on the power supply. Slowly increase the DC voltage until the armature winding is carrying 1.5 A of current as indicated by the 1.5 A dc meter (this is the nominal current value for the armature winding).
- c. Measure and record the voltage across the armature winding (plus brushes).

$$E_{\text{(armature)}} = \underline{40} \text{ V dc}$$

This value probably a little above or below 40 V dc. If above, use the 400 V dc range

- d. Return the voltage to zero and turn off the power supply.
- e. Calculate the resistance of the armature winding (plus brushes).

$$R_{\text{(armature)}} = E/I = \underline{40} / \underline{1.5} = \underline{26.6} \text{ } \Omega$$

- f. Calculate the  $I^2R$  losses of the armature (plus brushes).

$$P_{\text{(armature)}} = I^2R = \underline{2.25} \times \underline{26.6} = \underline{60} \text{ W}$$

G 10. Rotate the armature winding approximately 90(to the left).

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- a. The brushes are now making contact with different commutator segments.
- b. Repeat procedure 9.
- c.  $E = 40$  \_\_\_\_\_ V dc,  $R = 26.6$  \_\_\_\_\_  $\Omega$ ,  $P = 60$  \_\_\_\_\_ W

G 11. Rotate the armature 15(further to the left.

- a. Repeat procedure 9.
- b.  $E = 40$  \_\_\_\_\_ V dc,  $R = 26.6$  \_\_\_\_\_  $\Omega$ ,  $P = 60$  \_\_\_\_\_ W

**REVIEW QUESTIONS**

1. What would be the shunt field current of your motor if the shunt field winding is excited by 240 V dc?

$I = 0.33$  A dc

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2. If a current of 12 A dc flows in the series field winding of your motor, what would the resultant voltage drop be?

$E = 72$  V dc

---

3. If the rheostat were connected in series with the shunt field winding and the combination placed across a 240 V dc line, what shunt field current variations could be obtained from your motor?

$I_{\text{minimum}} = 0.14$  \_\_\_\_\_ A dc  $I_{\text{maximum}} = 0.33$  \_\_\_\_\_ A dc

4. All of the windings and even the commutator of your motor are made of copper.  
Why?

It is a excellent conductor

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Copper is better conductor than other elements and displays very low resistance to current flow. Resistance is an operator in power dissipation ( $I^2R$ ) and has to be as low as possible to prevent wastage due to coil warming. With lower power wastage, efficiency is raised and with the minimal heat to recede, the frame and motor volume and bulk can be made smaller.

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5. Why are the brushes of your motor made of carbon rather than copper?

There is a low friction between copper and carbon

The carbon brushes are cheap and easy to supersede. Use of carbon brushes ensure minimum wear on the commutator that is relatively expensive and complicated to supersede

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6. If the series field winding of your motor was connected directly across the 240 V dc supply:

- a) What current would flow?

$I = 40 \text{ A}$  \_\_\_\_\_

- b) What would the power loss be (in watts)?

$P = 9600 \text{ W}$  \_\_\_\_\_

- c) Is this power loss entirely given up as heat?

**G Yes** G No

- d) What do you think would happen to the winding if the current were sustained for a few minutes?

It would warm up and burn

---

7. What is meant by a “nominal current” or “nominal voltage”?

Current or a voltage at average load

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Military Technological College



8. If the armature winding and the series field winding of your motor were connected in series across a 240 V dc source, what would the starting current be?

$I = 7.3 \text{ A dc}$

---

9. In your motor, is the armature (plus brushes) resistance substantially the same for every rotational position of the armature? Explain.

☒ Yes ☐ No

But there probably variations.

Any little differences in resistance could be caused by connect pressure between a brush and commutator bar, dirt or film on the surface, or a small shortage on a commutator bar which can prevent most of the brush surface from contacting that special bar.

## Conclusion:

In this lap I have benefited how to deal with the dc motor and moreover studied how to make a connection and wiring. Also I did some measurement that belongs to the direct current motor. In addition I have a look for most important parts of Dc motor.

# Experiment 7

## Introduction:

A generator is an instrument which it can to transform mechanical energy into electrical energy. Also there are main four components of dc generator which is: Armature: is a wire which it rotate in the magnetic field. Brushes: is used to contact armature to the external circuit. Field winding: is used to output the magnetic flow in direct current generator and Commutator: is a ring of segments which there are segregate to each other's. Lastly, the application of dc generator are utilized for lighting purposes, utilized to charge the battery and utilized as a supply source of direct current motors.

## Discussion:

DC generator turn on the principle which when the coil of wire is round in a magnetic field. A voltage which it produced in the coil. The quantities of voltages produced is marked by the rate at which the coil is rotated in the magnetic field. There are two main kinds of direct current generator which is: 1. detached excited direct current generators: these dc generators have field magnet winding which they energized utilizing a different voltage source.

2. Self-Excited DC Generator: This dc generator have three types they are:

1) Series: Which the armature winding is connected in series with the field twisting so the field current courses out of the heap and the field winding. 2) Shunt: which the field winding is wired parallel to armature winding and the voltage across of both are same. 3) Compound

- G 1. Because of its constant running speed, the synchronous motor will be used to mechanically drive the DC generator. Using your Power Supply, AC Ammeter and Three-Phase Synchronous Motor/Generator, connect the circuit shown in Figure 7-1.

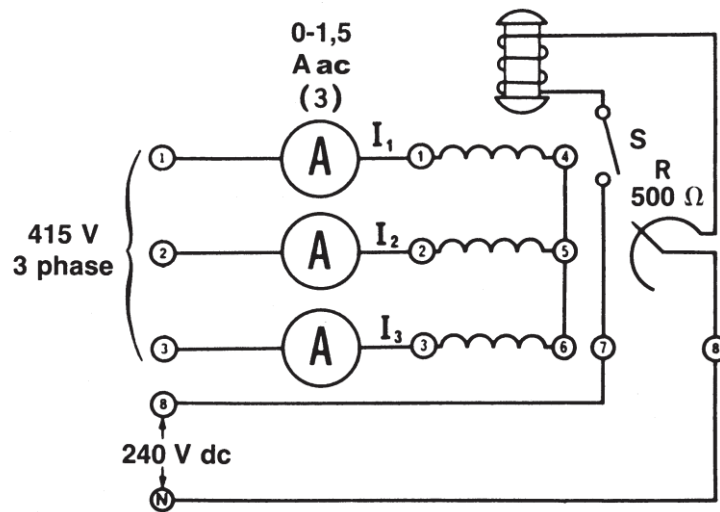


Figure 7-1.

**DO NOT APPLY POWER AT THIS TIME!**

- G 2. Terminals 1, 2 and 3 on the power supply provide fixed three-phase power for the three stator windings. (Three-phase power will be covered in later Experiments). Terminals 8 and N on the power supply provide fixed DC power for the rotor winding. Set the rheostat control knob to its proper position for normal excitation (Experiment 1, procedure 6).
- G 3. a. Using your DC Motor/Generator and DC Voltmeter/Ammeter, connect the circuit shown in Figure 7-2.
- b. Connect the shunt field of the generator, terminals 5 and 6, to the variable DC output of the power supply, terminals 7 and N, while connecting the 300 mA meter in series with the positive lead.
- c. Connect the 400 V dc meter across the generator output (armature terminals 1 and 2).
- d. Couple the synchronous motor and the DC generator with the timing belt.
- e. Make sure the brushes are in their neutral position.
- f. Have your instructor check your circuit.

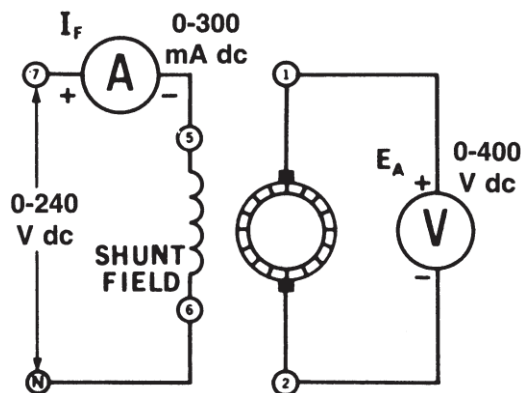


Figure 7-2.

**CAUTION!**

The switch in the excitation circuit of the synchronous motor should be closed (I) only when the motor is running.



- G 4. a. Turn on the power supply. The synchronous motor should start running.
- b. Close the switch S.

- c. Vary the shunt field current  $I_F$  by rotating the voltage control knob on the power supply. Note the effect on the generator output (armature voltage)  $E_A$  as indicated by the 400 V dc meter.
- d. Measure and record in Table 7-1 the armature voltage  $E_A$  for each of the listed field currents.

| $I_F$<br>(milliamperes) | $E_A$<br>(volts) |
|-------------------------|------------------|
| 0                       | 22               |
| 50                      | 74               |
| 100                     | 136              |
| 150                     | 198              |
| 200                     | 247              |
| 250                     | 287              |
| 300                     | 314              |

Table 7-1.

- e. Return the voltage to zero and turn off the power supply.
- f. Can you explain why there is an armature voltage even when the field current is zero?

A weakened magnetic field, caused by remaining stator flux, exists even when no excitement voltage is applied. Armature rotation within this field generates a little voltage

- g 5. a. Reverse the polarity of the shunt field by interchanging the leads to terminals 5 and 6 on the DC generator.
- b. Turn on the power supply and adjust for a field current  $I_F$  of 200 mA dc.
- c. Did the armature voltage reverse its polarity?  

G Yes

 G No
- d. Return the voltage to zero and turn of the power supply.

- G 6. a. Interchange the leads to the 400 V dc meter.  
b. Turn on the power supply and adjust for a field current  $I_F$  of 200 mA dc.  
c. Measure and record the armature voltage.

$$E_A = \underline{242} \text{ V dc}$$

- d. Is the armature voltage approximately the same as in procedure 4 (at an  $I_F$  of 200 mA), except for reversed polarity?

☒ Yes ☐ No

- e. Return the voltage to zero and turn off the power supply.

- G 7. a. Reverse the rotation of the driving motor by interchanging any two of the stator lead connections (terminals 1, 2 or 3) to the synchronous motor.  
b. Turn on the power supply and adjust for a field current  $I_F$  of 200 mA dc.  
c. Did the armature voltage reverse its polarity?

☒ Yes ☐ No

- d. Return the voltage to zero and turn off the power supply.

- G 8. a. Interchange the leads to the 400 V dc meter.  
b. Turn on the power supply and adjust for a field current  $I_F$  of 200 mA dc.  
c. Measure and record the armature voltage.

$$E_A = \underline{243} \text{ V dc}$$

- d. Is the armature voltage approximately the same as in procedure 4 (at an  $I_F$  of 200 mA), except for reversed polarity?

☒ Yes ☐ No

- e. Return the voltage to zero and turn off the power supply.

### Load Characteristics

- G 9. Set the supply voltage phase sequence of the synchronous motor as shown in Figure 7-1. Using your Resistive Load, connect the circuit shown in Figure 7-3. Place the resistance switches so that the total load resistance is 480  $\Omega$ .

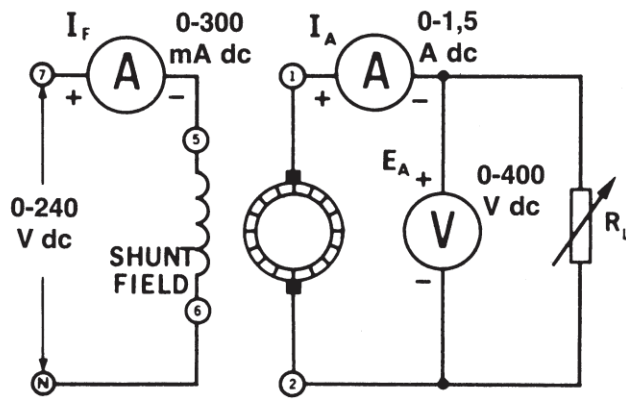


Figure 7-3.

- G 10. a. Turn on the power supply. The synchronous motor should start running.  
 b. Adjust the shunt field current  $I_F$  until the generator is delivering an output voltage of 240 V dc. The ammeter  $I_A$  should indicate 0.5 A dc.  
 c. Record the shunt field current  $I_F$ .

$$I_F = \underline{245} \text{ mA}$$

This is the nominal  $I_F$  at the rated power output ( $240 \text{ V} \times 0.5 \text{ A} = 120 \text{ W}$ ) of the DC generator.

- G 11. a. Adjust the load resistance to obtain each of the values listed in Table 7-2 while maintaining the nominal  $I_F$  value found in procedure 10.  
 b. Measure and record  $E_A$  and  $I_A$  for each of the resistance values listed in the Table. See table 27-2

**Note:** Although the nominal output current rating of the generator is 0.5 A dc, it may be loaded up to 0.75 A dc (50% overload) without harm.

| $R_L$<br>(ohms) | $I_A$<br>(amps) | $E_A$<br>(volts) | POWER<br>(watts) |
|-----------------|-----------------|------------------|------------------|
|                 | 0               | 280              | 0                |
| 2400            | 0.1             | 273              | 27.3             |
| 1200            | 0.2             | 265              | 53               |

|     |      |     |     |
|-----|------|-----|-----|
| 960 | 0.25 | 260 | 65  |
| 600 | 0.4  | 249 | 100 |
| 480 | 0.5  | 240 | 120 |
| 400 | 0.52 | 232 | 121 |
| 343 | 0.6  | 225 | 135 |
| 300 | 0.7  | 214 | 150 |

Table 7-2.

- G 12. a. With the load resistance adjusted for an output current  $I_A$  of 0.75 A, turn the field current  $I_F$  on and off by removing the connecting lead from terminal 6 to the DC generator.
- b. Do you notice that the driving motor is obviously working harder when the generator is delivering power to the load?

G yes

- c. Return the voltage to zero and turn off the power supply.

G 13. Calculate and record the power for each of the values listed in Table 27-2.

See table 7-2

- G 14. a. Place a dead short across the armature (terminals 1 and 2).
- b. Make sure that the power supply voltage control knob is turned down for zero field current.
- c. Turn on the power supply.
-  d. Gradually increase the field current  $I_F$  until the motor stalls.

**CAUTION!**

**Do not leave the motor in the stalled condition for more than a couple of seconds.**

- e. What value of shunt field current  $I_F$  is needed to stall the motor?

$$I_F = \underline{275} \text{ mA}$$

The motor have to start go slow at about 200mA and continue to slow down as excitement current is increased to 275 mA.

- f. Turn off the power supply.

**Note:** With short-circuit across the armature, its current becomes very large; this produces a strong braking effect sufficient to stall the driving motor.

#### REVIEW QUESTIONS

1. State two ways by which the output polarity of a shunt DC generator can be changed.

1) Reverse the polarity of the shunt field excitement.

2) Reverse the direction of rotation of the armature by reversing the driving motor.

2. If a DC generator delivers 180 W to a load, what is the minimum mechanical power (in watts) needed to drive the generator (assume 80% efficiency)?

225W \_\_\_\_\_

3. Plot the  $E_A$  vs  $I_F$  characteristic curve for your DC shunt generator on the graph of Figure 7-4. Use the data from Table 7-1. Note that the curve “bends over” as the field current increases. Can you explain why this happens?

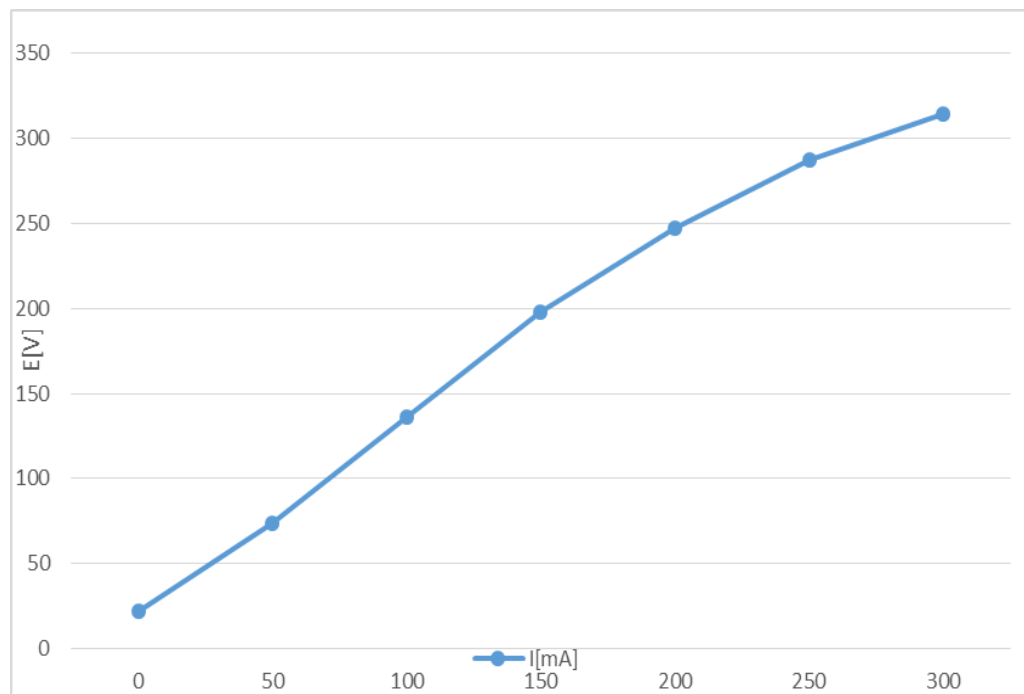


Figure 7-4

The "bending over" is due to magnetic saturation of the stator core. Where by an increase in the magnetizing current produces a smaller increase in magnetic field strength. See figure 7.4

- Plot the  $E_A$  vs  $I_A$  regulation curve on the graph of Figure 27-5. Use the data from Table 7-2.

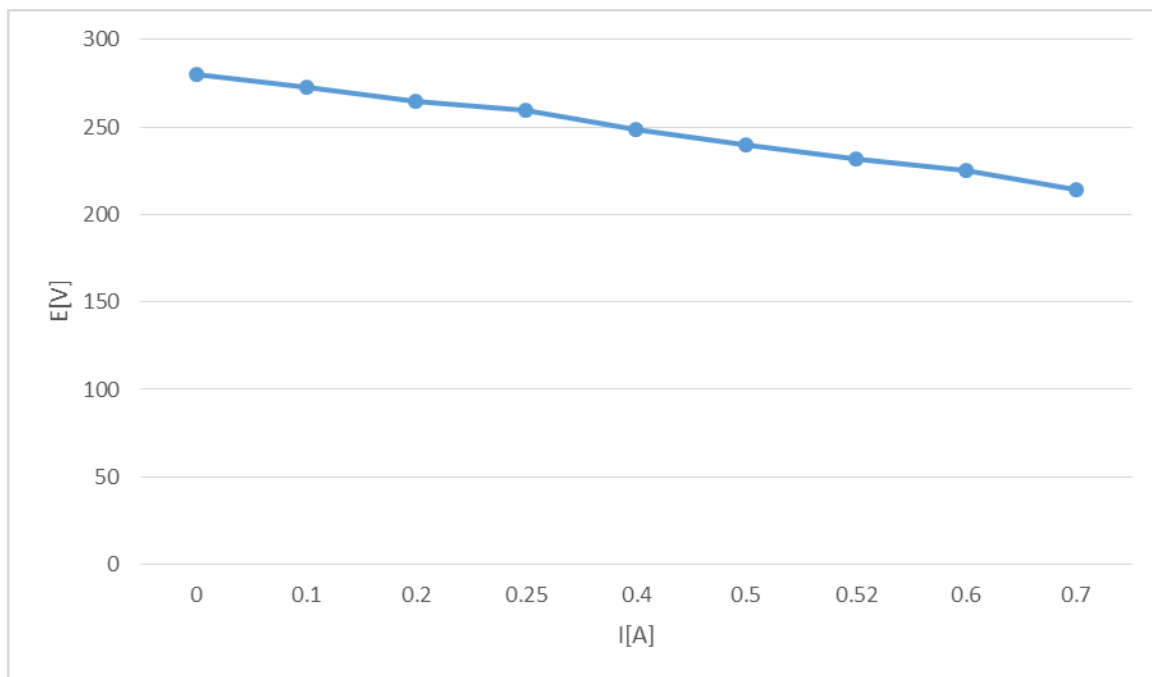


Figure 7-5.

5. Calculate the regulation from no-load to full-load (300 A dc).

$$\text{Regulation} = \underline{16.6} \%$$

### CONCIUSON:

In this lap I studied how to sketch a graph belongs to the measurement of dc generator. In addition I learnt the most important parts of direct current. Also I face some problem such as measure the armature voltage for each of the value field currents and I found the most possible solution by thinking closely.

**Shunt:** is a device which allows electric current to pass around another point in the circuit by creating a low resistance path

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