# UGANDA INSTITUTE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
# END OF SEMESTER ONE EXAMINATIONS

## ACADEMIC YEAR 2024/2025

**DEPARTMENT:** ICT

**SEMESTER:** ONE

**PROGRAMME(S):** DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING (DEEE)

**YEAR OF STUDY:** TWO

**COURSE:** DC MACHINES AND BATTERIES

**COURSE CODE :** ELT2103

**DATE:** SATURDAY 14TH, DECEMBER 2024

**TIME:** 2:00 PM – 5:00 PM

**DURATION:** 3 HOURS

**INSTRUCTIONS:**

(i) This paper contains two Sections: A (40 marks) & B (60 marks).

(ii) Attempt ALL questions in Section A, and ONLY THREE questions in Section B.

(iii) All questions in Section B carry equal marks.

(iv) Credit will be given for use of relevant examples and illustrations.

(v) Begin each number in Section B on a new page of the answer sheet.

**SECTION A [40 MARKS]**

Attempt **ALL** the Questions in this Section.

1. Differentiate between **lap** and **wave winding** as applied to DC Machines. **(4 marks)**
2. With the aid of diagrams, explain the following types of DC Machines.
   i) Shunt wound DC Machines **(2 marks)**
   ii) Series wound DC machines **(2 marks)**
3. Define armature reaction in DC machines. **(4 marks)**
4. Explain the effect of connecting a DC motor direct to the supply without the starter.
5. What do you understand by residual flux in a DC generator? **(4 marks)**
6. A dc shunt generator delivers 450A at a terminal voltage of 230V and the resistance of the shunt field and the armature are 50 and 0.03Ω. Calculate the generated emf. **(4 marks)**
7. An 8-pole d.c shunt generator with 778 wave – connected armature conductors and running at 500rpm supplies a load of 12.5Ω resistance at a terminal voltage of 50V. The armature resistance is 0.24Ω and the field resistance is 250Ω. Calculate the armature current. **(4 marks)**
8. An 8-pole d.c motor has a wave – wound armature with 900 conductors. The useful flux per pole is 25mWb. Determine the torque exerted when a current of 30A flows in each armature conductor. **(4 marks)**
9. A d.c motor operates from a 240V supply. The armature resistance is 0.2Ω. Determine the back emf when the armature current is 50A. **(4 marks)**
10. A 240V D.C shunt motor takes a total current of 30A. If the field winding resistance is 150Ω and the armature resistance is 0.4Ω. Determine the current in the armature. **(4 marks)**

**SECTION B [60 MARKS]**

Attempt **ONLY THREE** Questions in this Section.

**Question 1**

a) Differentiate between **self** and **separately excited** d.c generators **(4 marks)**

b) With the aid of a diagram explain the **three** types of self-excited generators. **(9 marks)**

c) A 30kW, 300V DC shunt generator has armature and field resistance of 0.05 and 100Ω respectively. Calculate the total power developed by the armature when it delivers full load output. **(7 marks)**

**Question 2**

a) Differentiate between **constant** and **variable losses** in d.c generator stating **two** examples for each. **(6 marks)**

b) Use clear illustration to show the power stages in a d.c generator. **(5 marks)**

c) A shunt generator supplies 96A at a terminal voltage of 200V. The armature and shunt field resistances are 0.1 and 50Ω respectively. The iron and friction losses are 2500W. find;

   i) Emf generated. **(3 marks)**

   ii) Copper losses. **(2 marks)**

   iii) Commercial efficiency. **(4 marks)**

**Question 3**

a) Outline **three** losses in a DC generator. **(3 marks)**

b) Derive the condition for maximum efficiency of DC generators. **(4 marks)**

c) A short-shunt compound DC generator supplies a current of 100A at a voltage of 220V. If the resistance of the shunt field is 50Ω, of the series field is 0.025Ω, of the armature is 0.05Ω, the total brush drop is 2V and the iron and friction losses amount to 1kW, find

i) The generated emf **(4 marks)**

ii) The copper losses **(3 marks)**

iii) The output power of the prime mover driving the generator **(3 marks)**

iv) The generator efficiency **(3 marks)**

**Question 4**

a) Explain the working principle of a DC motor. **(4 marks)**

b) Derive the power equation for a DC shunt motor and hence find the condition for maximum power. **(8 marks)**

c) (ii) A 20kW, 250V DC shunt generator has armature and field resistance of 0.1 and 125Ω respectively. Calculate the total armature power delivered when running as a;

i) Generator, delivering 20kW output. **(4 marks)**

ii) Motor, taking 20kW input. **(4 marks)**

**Question 5**

a) Define the term **speed regulation** as applied to DC motor and write down its expression. **(4 marks)**

b) State **two** practical fields of applications of dc shunt motors **(2 marks)**

c) Explain the three types of DC motor. **(6 marks)**

d) A Dc shunt generator delivers an output of 100kW at 500V when running at 800rpm. The armature and field resistances are 0.1 and 100Ω respectively. Calculate the speed of the same machine when running as a shunt motor and taking 100kW input power at 500V. Allow 1V per brush contact drop. **(8 marks)**