MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

**UNIVERSITY EXAMINATIONS
2021/2022 ACADEMIC YEAR**

SECOND YEAR SECOND SEMESTER EXAMINATIONS

FOR THE DEGREE OF

**BACHELOR OF SCIENCE
IN
MECHANICAL AND INDUSTRIAL ENGINEERING**

COURSE CODE: ECE 202

COURSE TITLE: ELECTRICAL MACHINES

DATE: Monday, April 25th, 2022 Time: 12.00- 2.00pm

INSTRUCTIONS TO CANDIDATES

ANSWER QUESTION ONE AND ANY OTHER TWO QUESTIONS.
QUESTION ONE CARRIES 30 MARKS AND ALL OTHERS 20 MARKS EACH.

TIME: 2 Hours

MMUST observes ZERO tolerance to examination cheating

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Question Two (20 marks)

a) State two materials that can be used to make the brushes of a DC machine.   **[1 mark]**

b) Explain four advantages of paralleling DC generators.   **[4 marks]**

c) A shunt generator delivers 200 A at terminal voltage of 240V. The armature resistance and shunt field resistance are 0.01Ω and 80Ω respectively. The iron and friction losses equal 750W. Neglecting brush losses, find:

   i) emf generated,
   ii) copper losses,
   iii) output of the prime motor.   **[6 marks]**

d) Define the following terms:

   (i) critical speed,   **[1 mark]**
   (ii) critical field resistance.   **[1 mark]**

e) State and elaborate four losses that occur in a DC machine.   **[4 marks]**

f) Name and draw three characteristics of a DC shunt generator.   **[3 marks]**

Question Three (20 marks)

(a) Mention three tests performed on a transformer and state the losses that can be determined   using   these   tests.
   [3 marks]

(b) Define an ideal transformer. State three characteristics of an ideal transformer. **[4 marks]**

(c) A 21.45-kVA, 3300/220-V distribution transformer is connected as a step-down autotransformer, with both the primary and secondary windings connected to the input and only the load connected to the secondary windings. *Draw a diagram* for this combination and determine:

   (i) the primary winding voltage,
   (ii) the secondary winding voltage,
   (iii) the ratio of transformation,
   (iv) the nominal rating of the autotransformer.   **[6 marks]**

(d) (i) Mention four ways in which a three-phase transformer can be connected.   **[2 marks]**

   (ii) A three-phase transformer which has a wye-delta connection is connected to a 12kV supply and draws a current of 10A. Considering the turns ratio of the transformer to be 12, determine:

(i) the air-gap power P_2,
(ii) the power converted P_m,
(iii) the output power P_{out},
(iv) the efficiency of the motor.   [5

marks]