



(University of Choice)

**MASINDE MULIRO UNIVERSITY OF  
SCIENCE AND TECHNOLOGY  
(MMUST)**

**MAIN CAMPUS**

**UNIVERSITY SPECIAL/SUPPLEMENTARY  
EXAMINATIONS  
2021/2022 ACADEMIC YEAR**

**FIFTH YEAR SECOND SEMESTER EXAMINATIONS**

**FOR THE DEGREE  
OF  
BACHELOR OF SCIENCE IN ELECTRICAL AND  
COMMUNICATION ENGINEERING**

**COURSE CODE: ECE 523  
COURSE TITLE: INDUSTRIAL ELECTRONICS**

**DATE: Thursday, 6<sup>th</sup> October, 2022**

**TIME: 12.00-2.00 pm**

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**INSTRUCTIONS TO CANDIDATES**

- i) Question **ONE (1)** is compulsory
- ii) Answer Any Other **TWO (2)** questions

TIME: 2 Hours

MMUST observes ZERO tolerance to examination cheating

1(a) Explain the methods of electric heating (2marks)

(b) Describe how a programmable logic controller works (4 $\frac{1}{2}$  marks)

(c) A 250 V dc shunt motor has armature resistance of 0.4 ohms, on load it takes an armature current of 60A and runs at 750 RPM. If the flux of the motor is reduced by 5% without changing the load torque, find the new speed of motor. (4 marks)

(d) Explain the fundamental principle of a modern supervisory control and data acquisition (SCADA) (6marks)

(e) Explain the FOUR essential functional operations of a digital data acquisition system (2marks)

(f) A plywood of 0.5 X 0.25 X 0.02 meter is to be heated from 25 to 125<sup>o</sup> in 10 minutes by dielectric heating employing a frequency of 30 mHz. Determine the power required in the heating process. Assume the specific heat of wood is 1500j/kg/<sup>o</sup>C; weight of the wood is 600kg/m<sup>3</sup> and efficiency of the process is 50% (5marks)

(g) Using relevant mathematical expression Linear Variable Differential Transformer (LVDT)

(4marks)

(h) highlight the 5 types of heating systems (2 $\frac{1}{2}$  marks)

2 (a). Explain how SCADA system is used to improve beverage production (2marks)

(b) (i) Draw the programmable Logic Control (PLC) ladder logic of the following and explain their meanings.

(i) AND gate (1mark)

(ii) NAND gate (1mark)

- (c) Explain the five 5 programming languages used in PLC (2 $\frac{1}{2}$  marks)
- (d) Explain how internet of things (IoT) help in enhancing the SCADA system (3marks)
- (e) (i) Define what is meant by distributed control system (DCS) (2marks)
- (ii) Highlight any two advantages of DCS over PLC (2marks)
- (f)(i) Describe infra-red heating (3marks)
- (ii) A 220 V DC shunt motor runs at 500 rpm when the armature current is 50 A. calculate the speed when the torque is doubled given that  $R_a = 0.2\Omega$  (3 $\frac{1}{2}$  marks)
3. a.) Explain the working principle of the photomultiplier tube (3marks)
- b) Describe the properties of the following particles:
- i. Alpha particles (2marks)
- ii. Gamma rays (2marks)
- c.) Explain how particles mentioned in 3(i) can be detected and measured using Geiger Muller tube (5marks)
- d) Explain how measurement of liquid level is achieved using the following techniques
- i. Gamma rays (4marks)
- ii. Ultrasonic method (4marks)
4. a.) i) Draw the block diagram of the digital data acquisition system and explain the functions of the various components of the block. (10 marks)
- ii. Name and explain the functions of the two types of data acquisition system. (4marks)
- b.) In the measurement of liquid level, explain using an appropriate diagram how a float operated voltage potential divider can be used to determine liquid level. (6marks)
- (5)(a)(i) State any three properties of ultrasonic waves (3mks)
- (ii) State any two application of ultrasonic waves (2mks)
- (b)(i) Define the term cascade control giving an example (3mks)
- (ii) State the three disadvantage of cascade control (3mks)
- (c) state any three characteristics of a good heating element (3mks)

(d) A resistance oven employing a Nichrome wire is to be operated from 220 V single phase supply and it is to be rated at 16KW. if the temperature of the element is to be limited to 1170°C and average temperature change is 500°C find the diameter and the length of the elements wire.

Radiating efficiency=0.57, emissivity=0.9, specific resistance of Nichrome =  $109 \times 10^{-8} \Omega$   
[6mks]