(University of Choice)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

UNIVERSITY EXAMINATIONS 2018/2019 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: Friday 24th May , 2019 **TIME:** 08.00 a.m to 10.00 a.m

INSTRUCTIONS TO CANDIDATES

Question ONE (1) is compulsory
Answer Any Other TWO (2) questions

TIME: 2 Hours

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 3 Printed Pages. Please Turn Over.

QUESTION ONE (30MARKS)

(a) Define the following terms as used in electric heating:

(i) Conduction (1mark)

(ii) Radiation (1mark)

(iii)Convection (1mark)

(b) State any **FOUR** factors which determine the choice of frequency in induction heating (2marks)

(c) Explain the piezoelectric phenomenon (4mark)

(d) A cubic tank has surface area of $6.0m2$ and is filled to 90% capacity six times daily. The water is heated from $20°C$ to $65°C$. The losses per square meter of tank surface per $1°C$temperature difference is $6.3W$. find the loading in kW and the efficiency of the tank. Assume specific heat of water is $4200J/kg/°C$ and $1kwh = 3.6MJ$ (3marks)

(e) The velocity of ultrasound in a commercial preparation of lead zirconate titanate, a commonly used piezoelectric ceramic material, is $4{,}000m/s$.

(i) If a vibration frequency of 5 MHz were desired, what would be the crystal thickness? (3marks)

(ii) For the same frequency, explain how better resolution could be achieved in the case of imaging applications (6marks)

(f) Figure Q1f illustrates a typical on-delay programmed timer. Explain its operation. (9marks)

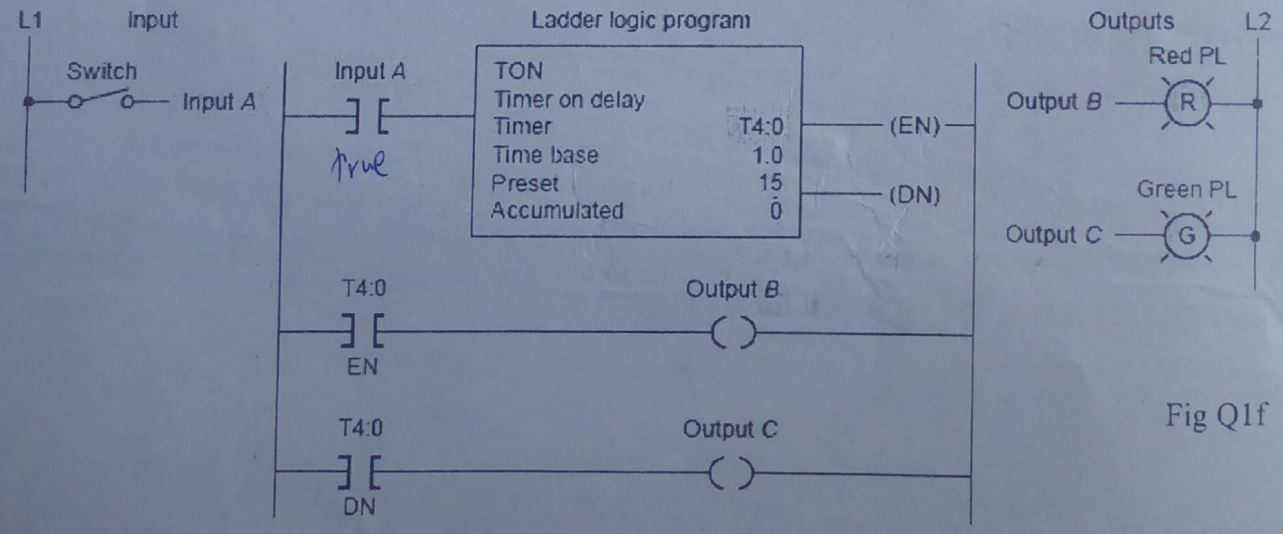

Fig Q1f

QUESTION TWO (20MARKS)

(a) Using transformer action, explain how inductive sensors measure displacement (6marks)

(b) From first principles show that the power per unit volume in dielectric heating can be expressed as: (Define all terms and symbols used) (4marks)

$$P_v = 2\pi f.\varepsilon_o\varepsilon_r.(p.f).v^2 Wm^{-2}$$

(c) With the aid of a neat and well labeled diagram, write PLC ladder logic instructions to start a motor after 15 seconds and to stop the motor after 100 packets of raw material have been completely packed. The program should also control remote standby and run pilot lights. (10marks)

QUESTION THREE (20MARKS)

(a) Define the term welding and differentiate between plastic welding and fusion welding. (3marks)

(b) With the aid of a neat and well labeled diagram and relevant mathematical equations, show how signal conditioning of resistive elements could be achieved (9marks)

(c) With the aid of neat and well labeled diagrams, explain how ultrasound could be produced from multi-crystal transducers (8marks)

QUESTION FOUR (20MARKS)

(a) With the aid of neat and well labeled diagrams, explain any **FIVE** different methods of how temperature control of resistance furnaces could be achieved (20marks)

QUESTION FIVE (20MARKS)

(a) State and explain **THREE** requirements for a good heating element (3marks)

(b) Define and state any **TWO** advantages of the term resistance welding. (3marks)

(c) With the aid of a neat and well labeled diagram, show and explain the essential components of a single Piezoelectric Crystal for the purposes of producing ultrasound (14marks)

END