MACHAKOS UNIVERSITY

University Examinations for 2022/2023 Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

FORTH YEAR SECOND SEMESTER EXAMINATIONS FOR

BACHELOR OF SCIENCE…………………………………………

SPT 420: MICROCONTROLLERS AND PLC TECHNOLOGY

DATE: TIME:

INSTRUCTIONS

Answer question **ONE** and **ANY OTHER TWO** questions

QUESTION ONE (COMPULSORY) (30 MARKS)

a)   Describe briefly the following solutions that PLCs offer.
     i.   Reliability;
     ii.   Flexibility.

(2 marks)

b)   An oil pump is switched on in order to provide lubrication to the gear box of a main motor. Under the precondition of the operating state of the oil pump, the main motor is switched on to operate. During the operation of main motor, the oil pump needs to provide lubrication continuously. The oil pump is then stopped and thereafter the main motor is also stopped.

Inputs
X0 – START pushbutton to Start Oil Pump Motor
X1 – START pushbutton to Stop Main Motor
X2 – STOP pushbutton to Stop Oil Pump Motor
X3 – STOP pushbutton to Stop Main Motor
Outputs

Y0 – Oil Pump Motor
Y1 – Main Motor
Design the PLC ladder logic for this system.

(6 marks)

c)   i.   List the timer instruction of PLC;
     ii. Explain the ON delay timer in details.   (6 marks)

d)   State any four addressing mode of 8051 µC and explain each with example.
                                                                    (8 marks)

e)   i.   Draw the interfacing diagram of stepper motor with 8051 microcontroller
     ii. Write an assembly language program to rotate the stepper motor
          continuously in anti-clockwise direction. Assume step angle is 0.9/step.
                                                                    (6 marks)

f)   Describe the function of data and control bus.
                                                                    (2 marks)

QUESTION TWO (20 MARKS)

a)   Draw ladder diagram to blink LED continuously for 60 times. LED should be
     ON for one second and OFF for one second.
                                                                    (6 marks)

b)   Draw ladder diagram for 2 motor operations for following condition:
     (i) Start push button start motor M1 & M2
     (ii) Stop push button stop motor M1first & after 10 seconds motor M2.
                                                                    (8 marks)

c)   Write assembly language program to perform and AND, OR and XOR operation
     on two data. Data 1 is at internal RAM location 40 H and Data 2 is at external
     memory location 2000 H. Store result at three successive locations in internal
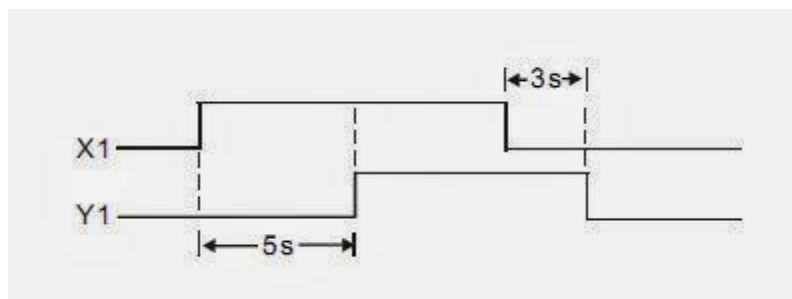   RAM i.e. 50 H, 51 H and 52H respectively.   (6 marks)

QUESTION THREE (20 MARKS)

a)   Given the controller Boolean algebra equation below, obtain the ladder logic
     circuit.

$$A = \bar{B} \cdot (\overline{C \cdot (\bar{D} + E + \bar{C})} + \bar{F} \cdot C)$$

                                                                    (4 marks)

b)   The waveforms below show a control system of enabling an indicator to be ON
     after a 5 sec delay and OFF after a 3 sec delay using a switch and two timers.

Number of PLC Inputs Required
X1 – Start Switch.
Number of PLC Timers Required
T0 – 5 second Timer, 100 ms Time Base.
T1 – 3 second Timer, 100 ms Time Base.
Number of PLC Outputs Required
Y1 – Output Indicator

Design the PLC ladder logic for this system.   (6 marks)

c)

FigQ3 (c) shows a product counting and packing system using a conveyor belt. It uses a photoelectric sensor to detect products and a robotic arm to pack them up. Once the photoelectric sensor detects 10 products, the robotic arm begins to pack them up. When the action is completed, the robotic arm and the counter are reset.
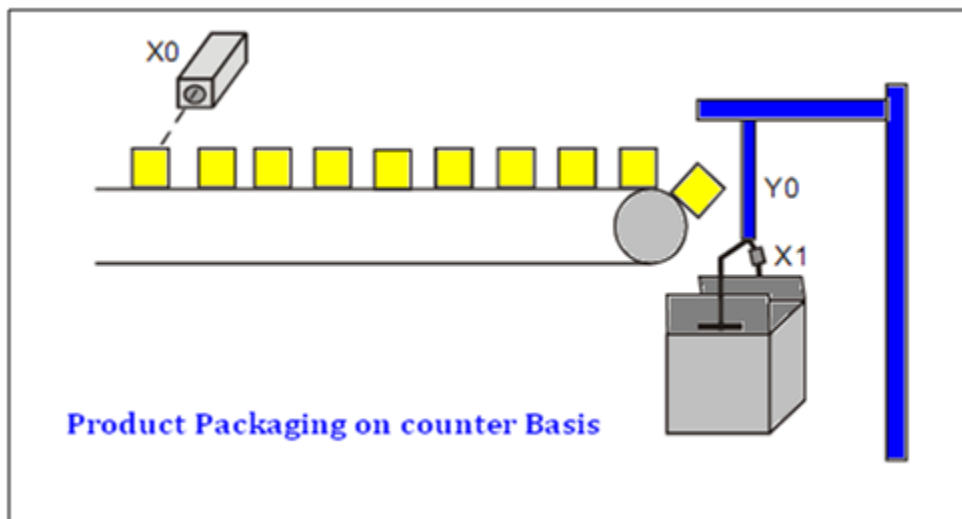
FigQ3 (c)

Inputs

X0 – Photoelectric sensor for counting products. X0 = ON when products are   detected.
X1 – Robotic arm action completed sensor.
X1 = ON when packing is completed.
Number of counters
C0 – Counter: 16-bit counting up (general purpose)
Output
Y0 – Robotic arm for packing
Design the PLC ladder logic for this system.

                                                                    (6 marks)

d)   Write an assembly language program, for 8051 microcontroller to perform
        addition of three 8 bit numbers. These numbers are stored at internal memory
        location 60 H, 61 H AND 62 H. Store carry and sum at 63H and 64 H location.
        (Assume suitable data).

                                                                        (4 marks)

QUESTION FOUR (20 MARKS)

a)   Write addressing modes for following instructions:
        i   ADD A, R0
        ii.   ADD A, #20h
        iii.   ADD A, 50h
        iv.   ADD A, @R0

                                                                        (4 marks)

b)   Explain the following instructions:

        i.   MOVC A, @ A+DPTR
        ii.   RRC A
        iii.   SWAP A
        iv.   XCHD A, @RO

                                                                        (4 marks)

c)   What is content of A after execution of following program:
        CLR A
        CPL A
        ANL A,# C0h
        RR A
                                                                        (4 marks)

d)   Compare Timer and Counter operation in 8051 microcontroller.

                                                                        (4 marks)

e)   With the help of neat diagram explain the concept of sourcing and sinking DC
        input module of PLC.
                                                                        (4 marks)

QUESTION FIVE (20 MARKS)

a)   Write an assembly language program for 8051 microcontroller for finding the
        largest number in a given set of 05 numbers. (Assume suitable data/memory
        addresses)
                                                                        (6 marks)
b)   i.   Draw interfacing diagram of relay with 8051 microcontroller.
        ii.   Write an assembly language program to turn ON and OFF relay.

                                                                        (6 marks)

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c)   Draw the ladder diagram for 2 major operations (i-iii and ii-iv).
     i.   When start button is pushed motor M1 and M2 start.
     ii.   After 10 sec. motor M1stops.
     iii.   Motor M2 stops 15 sec. after motor M1 has stopped.
     iv.   Both M1 and M2 will stop when stop push button is pressed.

(8 marks)