THE COPPERBELT UNIVERSITY
SCHOOL OF ENGINEERING
ELECTRICAL DEPARTMENT
2021-2022 SESSIONAL EXAMINATIONS

EMBEDDED SYSTEMS(EF461 EXAM)
TIME ALLOWED:3 HOURS

- The paper contains 6 Questions

- Each question carries 12 marks

- Answer all Questions in section A and any 3 in section B

- Illustrate your solutions with suitable diagrams and show all essential working. Failure to do so will result in loss of marks

August 9, 2022

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SECTION A:

1. The atmega 32 Microcontroller is one of the microcontrollers used today. Given the code 0b00011101,answer the following

   (a) Use appropriate assembly commands permitted to load the given code to location address $0x0062 of the SRAM of the microcontroller
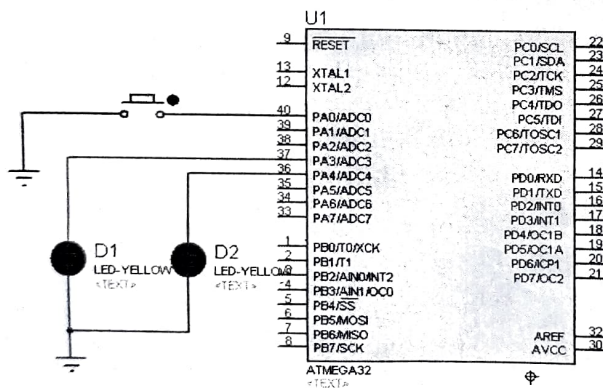
   2marks ✓

   (b) Use appropriate assembly commands permitted to load the given code which is now at location address $0x0062 to PORTB of the the microcontroller

   5marks

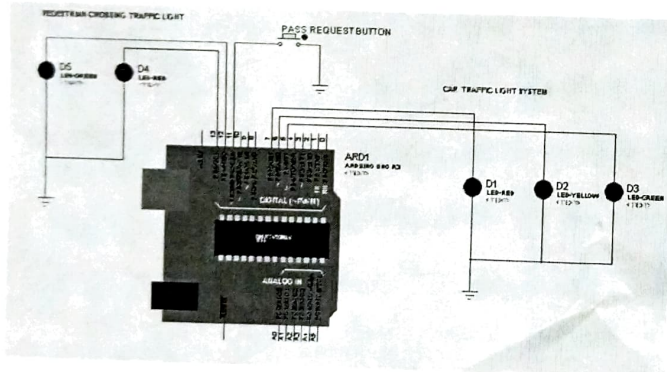   (c) briefly explain and show with examples how COUNTERS,ALU and CONTROL/DATA BASSES are used.

   5marks

2. Given the circuit below,the status of LED 1 and LED2 should be on by default.Write the correct assembly code to immediatetly switchoff both LEDs from a pressed button and after 1 after one second from off state both LEDs should come on.The button is located at PORTA0.LED 1 is located at PORTA3 and LED2 at PORTA4

12marks

3.0 Given the circuit below of an interactive traffic Light with the arduino Uno microcontroller Write the C++ program for the traffic light as described. The pass request Button, the pedestrian traffic Light and the car traffic Light are connected as shown below. Programe description: The pedestrian traffic Light is engaged whenever the user presses a button passing a request to pass. If a button is pressed, the programe should check if 5seconds have passed since the Last time the button was pressed. If so, Traffic Lights should exchange from Car Traffic Light to pedestrian traffic Light. If not the car traffic Light system continues. Below is the decriptions of time Transitions. Defaut Status: Car Traffic LED GREEN ON by deafult, Yellow off and LED Red OFF; Pedestrian Traffic Light : LED RED ON by default green off: This is the status when the system is just engaged. If the condition of pressing the button is satisfied, for the car traffic Light: LED green goes off. LED Yellow comes on and stays for 2seconds after which it goes off and LED RED comes on after this a delay of 1 second takes place before the Pedestrian LED Red goes off to exchange with the Pedestrian LED Green which comes on. After this the pedestrian traffic will take 5 seconds to allow pedestrians to pass. after 5 seconds the Led Green Pedestrian flashes 10 times before switching to Defaut Status: Car Traffic LED GREEN ON by deafult, Yellow off and LED Red OFF; Pedestrian Traffic Light : LED RED ON by default green off

12marks

$D_1 \rightarrow$ Red (off)

$D_2 \rightarrow$ Yellow (off by def) } Traffic

$D_3 \rightarrow$ GREEN (on by default)

$D_4 \rightarrow$ Green (off by default)

$D_5 \rightarrow$ RED (on by default)

D_4 & D_5 go on whe PB is pressed

press button

delay (5000);

if (x == delay(5000))

digitalWrite (D1 &

if & to

else digital write

D_3 & D_4 & D_5

HIGH

$$\frac{DV}{1024} = \frac{AV}{5V}$$

$$AV = \frac{DV \times 5V}{1024}$$

$$Temp = AV \times 100$$

4. Given the circuit below with the arduino Uno microcontroller with the temperature sensor connected to A0 Write the correct C++ program such that when temperature goes beyond 27deg Celcious D1 which is on by default switchess off and D2 which is off by default comes on
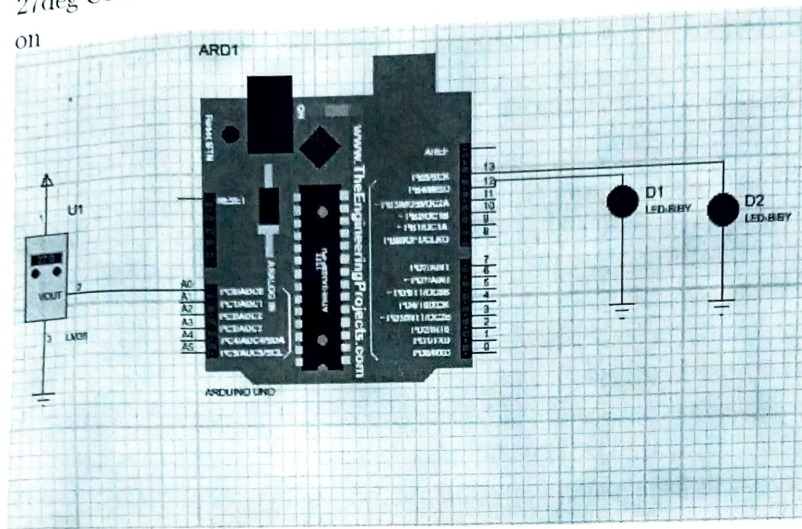
12marks

5. Given the scenario below answer the questions that follow(LS1 is normally closed and LS2 is normally open
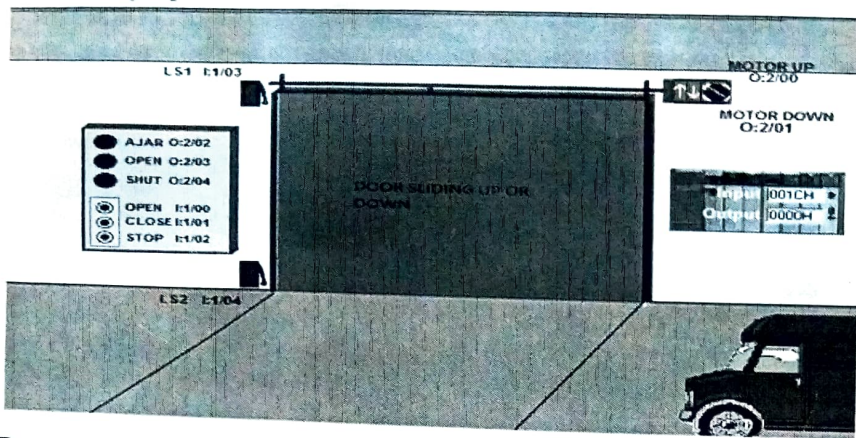
Design a program which will maintain the appropriate door movement once initiated by the operator. Write the program using PLC Ladder logic. The program will adhere to the following criteria:

• Door movement will halt immediately when the Stop Switch is initially pressed, and will remain halted if the switch is released. • Pressing the Open Switch will cause the door to Open if not already fully open. The opening operation will continue to completion even if the switch is released. • Pressing the Close Switch will cause the door to Close if not already fully shut. The closing operation will continue to completion even if the Switch is released. • If the Door is already fully opened, pressing the Open Switch will Not energize the motor. • If the Door is already fully closed, pressing the Close Switch will Not energize the motor. • Under no circumstance will both motor windings be energized at the same time. • The Ajar Lamp will be illuminated if the door is NOT in either the fully closed or fully opened position.• The Open Lamp will be illuminated if the door is in the Fully Open position. •The Shut Lamp will be illuminated if the door is in the Fully Closed position

USEFUL TABLE

ITEM	ADDRESS OF BIT BOX	STATUS IN BIT BOX
OPEN BUTTON	I:1/00	0
CLOSE BUTTON	I:1/01	0
STOP BUTTON	I:1/02	1
AJAR	0:2/02	0
OPEN LAMP	0:2/03	0
SHUT LAMP	0:2/04	0
MOTOR UP	0:2/00	0
MOTOR DOWN	0:2/01	0
Limit Switch 1(LS1)	I:1/03	1
Limit Switch 2(LS2)	I:1/04	0

12marks

6

Given the scenario below of a silo demonstrating sequence control. Write the PLC program. The box on the conveyor box is expected to move and stop by the proximit sensor after which the solonoid valve is expected to open and the box refilled. When the level sensor senses the required hight of the refilled box.the box continues to exit.
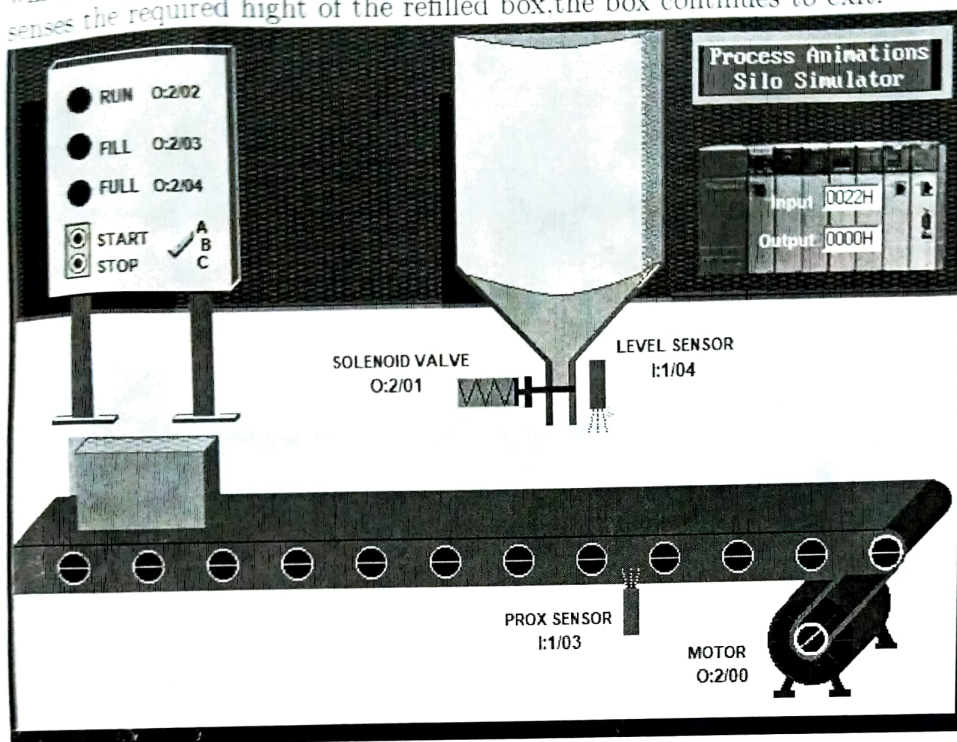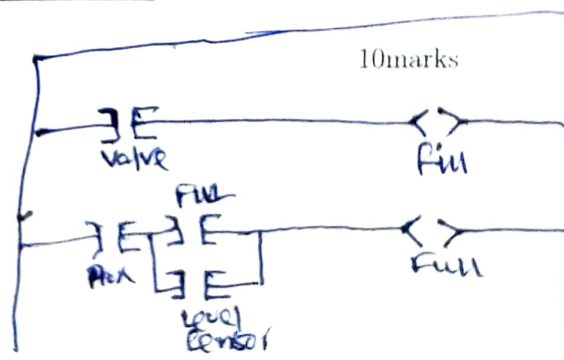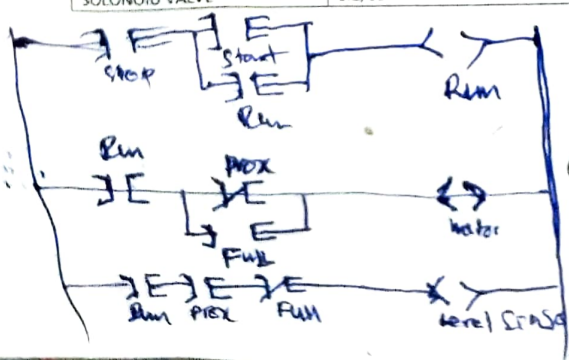

The program will adhere to the following criteria:

- the sequency can be stopped and started at any time using the panel mounted stop and start switches.
- The RUN light will continue operating for as long as the system is operating automatically
- The RUN light,Conveyor Motor and Solenoid will denergise whenever the system is halted via a stop switch
- The fill light will energise while the box is filling
- The full light will energise for as long as the box is full and will remain that way until the box has moved clear of the full prox-sensor

Useful Table

ITEM	ADDRESS OF BIT BOX	STATUS IN BIT BOX
Level Sensor(normally open)	I:1/04	0
Prox-Sensor (normally open)	I:1/03	0
START BUTTON(normally open)	I:1/05	0
STOP BUTTON(normally closed)	I:1/06	0
MOTOR	O:2/00	0
RUN Light	O:2/02	0
FILL Light	O:2/03	0
FULL Light	O:2/04	0
SOLONOID VALVE	O:2/01	0

10marks

6