

**UNIVERSITY OF SWAZILAND
FACULTY OF SCIENCE
DEPARTMENT OF ELECTRONIC ENGINEERING**

MAIN EXAMINATION MAY 2009

TITLE OF PAPER: INDUSTRIAL ELECTRONICS

COURSE CODE: EIN520

TIME ALLOWED: THREE HOURS

INSTRUCTIONS:

1. Answer question **one** (1) and any other three (3) questions.
2. Question one carries 40 marks.
3. Questions 2, 3, 4, and 5 carries 20 marks.
4. Marks for different sections are shown in the right-hand margin.

This paper has 6 pages including this page.

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BY THE INVIGILATOR.**

Question 1

Design a telemetry circuit required to transmit temperature readings ranging from 0°C to 100°C.

A block diagram of the circuit is shown in Figure 1 and the following are the specifications

Temperature sensor circuit

The output of the sensor circuit is linear and gives the following readings:

0.8 volts at - 50°C

0.3 volts at 150°C

Signal conditioner

The output of the signal conditioner should range from 2 volts to 10 volts.

PWM

The PWM comprises of two 555 timers.

Oscillator: $T = 20$ msec and 50% duty cycle

Duration of the variable one shot: $t_p = 18$ msec

(40 marks)

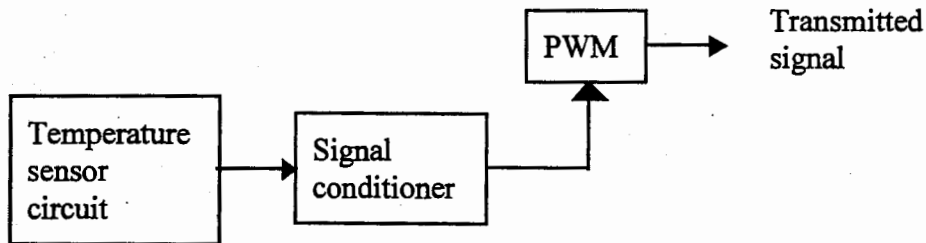


Figure 1

Question 2

A) when a computer controlling a plant fails, or a programmer misunderstands the plants operation, the result could be injuries or fatalities, and under the Health and Safety at Work Act the design engineers could be prosecuted. State five (5) requirements for an industrial control computer. (10 marks)

B) List six steps you should follow when commissioning a PLC. (10 marks)

Question 3

To keep track of items a sensor might be used to detect faulty items moving along a conveyor and keep track of it so that when it reaches the appropriate point a reject mechanism is activated to remove it from the conveyor. Figure 3 illustrates this arrangement.

Produce a ladder diagram using Mitsubishi PLC addressing.

Hint: Use a shift register.

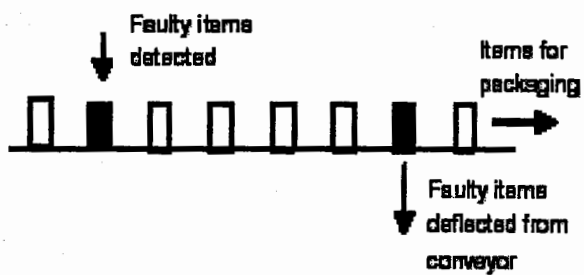


Figure 3

Question 4

4. a) Sketch the connections needed for the PLC inputs and outputs shown in Figure 4. The outputs include a 24Vdc light and a 220Vac light. The inputs are from two normally open push buttons, and also from an optical sensor that has both PNP and NPN outputs.

b) State why you used either the NPN or PNP output on the sensor.

(20 marks)

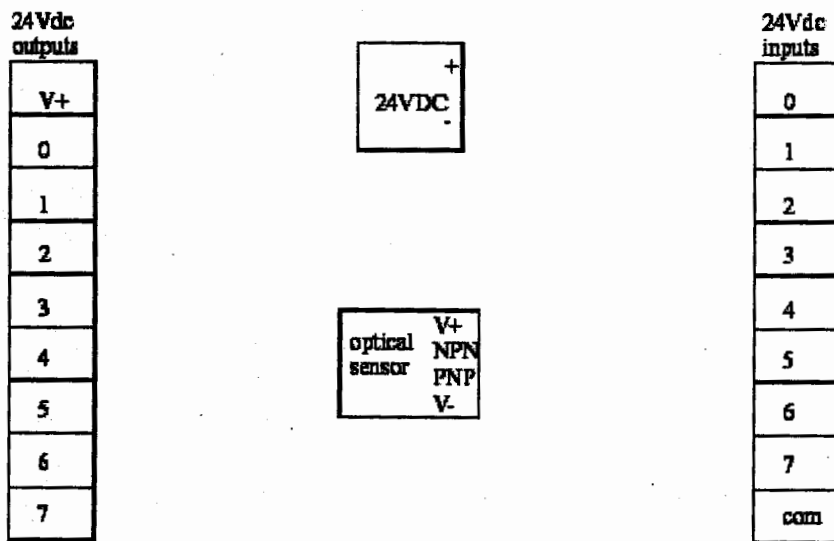


Figure 4

Question 5

a) A piezo-electric pressure transducer has a sensitivity of 80 pC/bar. If it has a capacitance of 1nF and the pressure to be measured ranges between 1.0 bar and 100.0 bars.

(i) Determine its output voltage range. (4 marks)

(ii) Number of bits required for a display. Assuming 10 volts full scale input is required for the display. (8 marks)

b) Various amplifier designs are used to boost the position error signal so that it can drive an ac servo motor's control winding. State four techniques commonly used. (8 marks)