

**CONFIDENTIAL****UNIVERSITI TUN HUSSEIN ONN MALAYSIA****FINAL EXAMINATION  
SEMESTER II  
SESSION 2016/2017**

**COURSE NAME : INDUSTRIAL ELECTRONIC**  
**COURSE CODE : BND 22303**  
**PROGRAMME CODE : 2 BND**  
**EXAMINATION DATE : JUNE 2017**  
**DURATION : 2 HOURS AND 30 MINUTES**  
**INSTRUCTION : ANSWER FOUR (4) QUESTIONS ONLY**

**THIS QUESTION PAPER CONSISTS OF SEVEN (7) PAGES**

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**Q1 (a)** Figure Q1(a) forms part of an instrumentation amplifier circuit. Show that

$$\frac{v_{od}}{v_{id}} = \frac{v_{o1} - v_{o2}}{v_{i1} - v_{i2}} = 1 + \frac{2R_f}{R_1}$$

Hint: Calculate the value of  $i$  going through  $R_1$  first.

(7 marks)

**(b)** Figure Q1(b) shows an adjustable AC load controller utilizing phase angle delay technique:

(i) State the function of operational amplifier U1a

(2 marks)

(ii) State the function of operational amplifier U1c

(2 marks)

(iii) Suppose the value of P1 is 50 kΩ, what is the direction and value of the current charging the capacitor C1?

(4 marks)

(iv) Obtain the waveforms at point A, B, C, D, E & F.

(10 marks)

**Q2 (a)** Figure Q2(a) shows part of the ladder diagram of a process. Convert the ladder diagram into mnemonic codes.

(7 marks)

**(b)** Figure Q2(b) shows a continuous bottle-filling control scheme in which it is necessary to implement a control program that detects the position of a bottle via a limit switch, waits 0.5 seconds, and then fills the bottle until a photosensor detects a filled condition. After the bottle is filled, the control program will wait 0.7 seconds before moving to the next bottle. The program begins with the start and stop circuits for the outfeed motor M2. Once the start push button is pushed, the outfeed motor will turn ON until the stop push button is pushed. The feed motor M1 will be energized once the system starts (M2 ON); it will stop when the limit switch detects a correct bottle position.

When the bottle is in position and 0.5 seconds have elapsed, the solenoid will open the filling valve and remain ON until the photoeye (PE) detects a proper level. The bottle will remain in position for 0.7 seconds, then the energized internal logic will start the feed motor. The feed motor will remain ON until the limit switch detects another bottle. Based on the above information and criteria and that a PLC is to be used for controlling the process:

- (i) Identify all input and output components and assign address to each unit (4 marks)
- (ii) Perform the internal and register assignments (4 marks)
- (iii) Draw the I/O connection diagram and the ladder diagram (10 marks)

**Q3** Figure Q3 shows the power circuit and the control circuit of a Forward-Reverse Direct-on-Line starting scheme. The electromechanical control circuit needs to be replaced with a PLC unit with essential accessories. To do that the following need to be performed:

- (i) Reproduce the control circuit and then identify the real inputs and outputs by circling each I/O element (7 marks)
- (ii) Assign the I/O addresses, assuming input memory location starting at 000 till 007 while output memory location starting at 030 to 037 (5 marks)
- (iii) Draw the I/O connection diagram and the ladder diagram when a PLC is used. (13 marks)

**Q4** (a) Figure Q4(a) shows a double acting cylinder in the process of extending the piston after the depression of a start push button. The piston shall stop and retreat when the limit switch S2 is actuated by the extending piston.

- (i) Produce the appropriate control circuit for controlling the cylinder (4 marks)
- (ii) Show the connection of the cylinder and the control valve during the retracting cycle. (2 marks)

(b) A double acting cylinder is to be used to perform to and fro operation with positions of starting and ending marked by sensors S1 and S2 respectively. The piston will move forward when PB1 button is pressed and continue to and fro motion till 10 cycles of operations is performed. The whole cycle will be repeated when PB1 is pressed again. However the process can be interrupted at any time when the stop pushbutton PB2 is pressed. You are to design a pneumatic control circuit incorporating with the use of PLC. It is recommended that a 5/2 way doubled solenoid valve is to be used in conjunction with the cylinder. You may need to pick a memory device and a counter or other accessories for this design:

- (i) List out the main components/parts/equipment for this design (3 marks)
- (ii) Draw and label the pneumatic diagram (3 marks)
- (iii) Draw the PLC I/O wiring diagram (3 marks)
- (iv) Draw the PLC program ladder diagram to implement this task (10 marks)

**Note:** To facilitate uniformity and ease of identification, you may use I1, I2, .. and O1, O2.. for your PLC I/O reference and other appropriate coding in the ladder diagram.

**Q5** The opening and closing of a door is controlled by using a double acting cylinder. The opening of the door is activated by pressing a push button switch PB1. When PB1 is pressed, the door is open (piston starts to extend). Limit switch LS1 will detect the full extension of piston (door is fully open). The door remains open for 10 seconds and after which it is automatically closed.

You are asked to design the project by using a 5/2 way directional valve and assume the traveling time for piston from original position to full extension and vice versa to be 1.0 second duration. For future reference you are asked to produce the following documentation:

- (i) To list out input and output components involved (3 marks)
- (ii) Draw the grafcet (3 marks)
- (iii) Draw the motion diagram (3 marks)
- (iv) Draw the displacement diagram (3 marks)
- (v) Draw the pneumatic circuit connection (8 marks)
- (vi) Draw the electric control diagram (5 marks)

**- END OF QUESTION -**

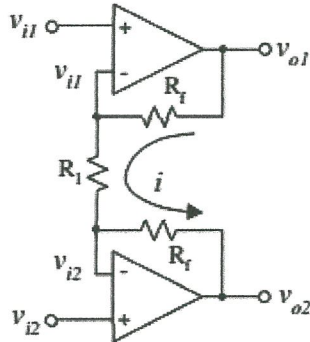
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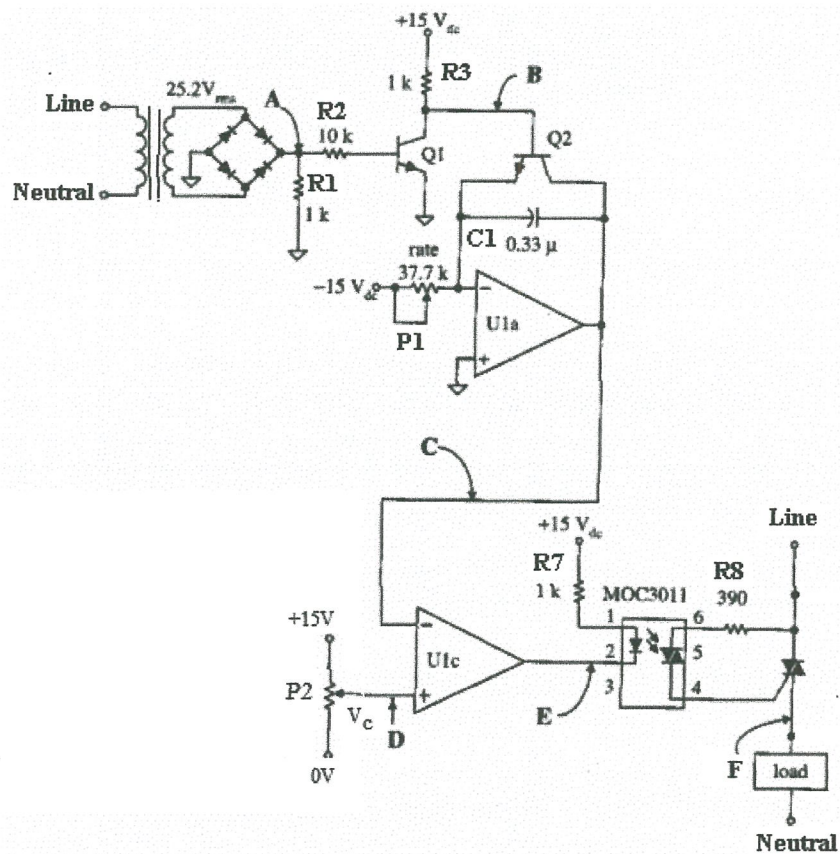
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**Figure Q1(a)**



**Figure Q1(b)**

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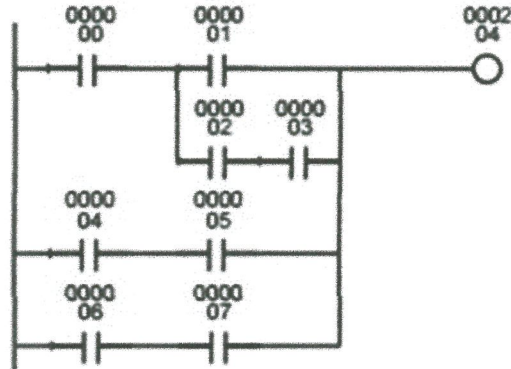


Figure Q2(a)

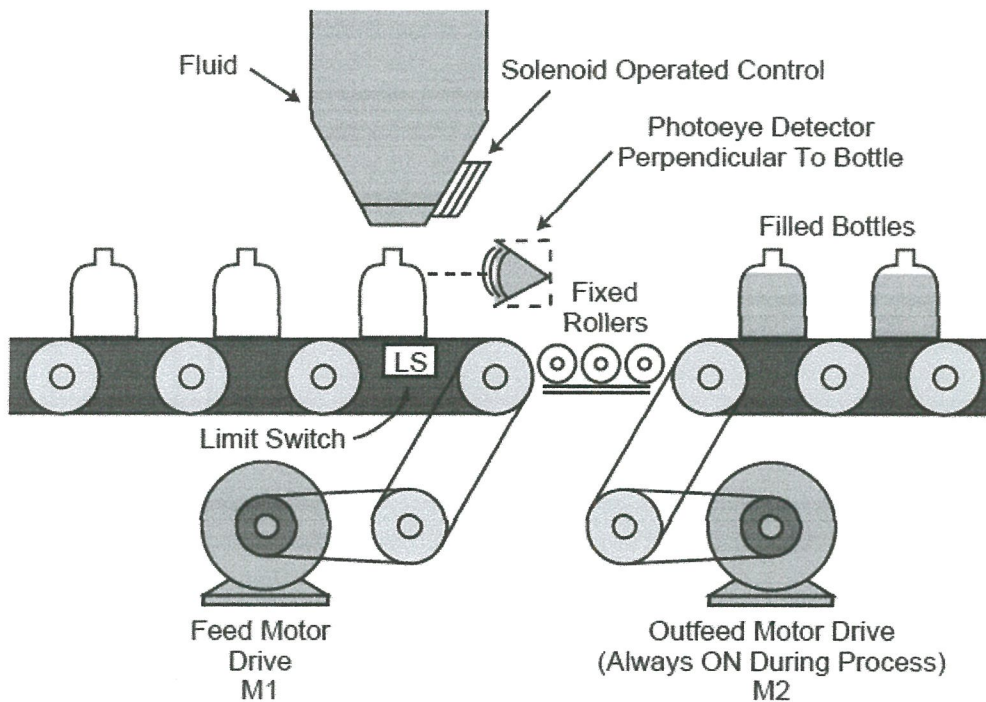


Figure Q2(b)

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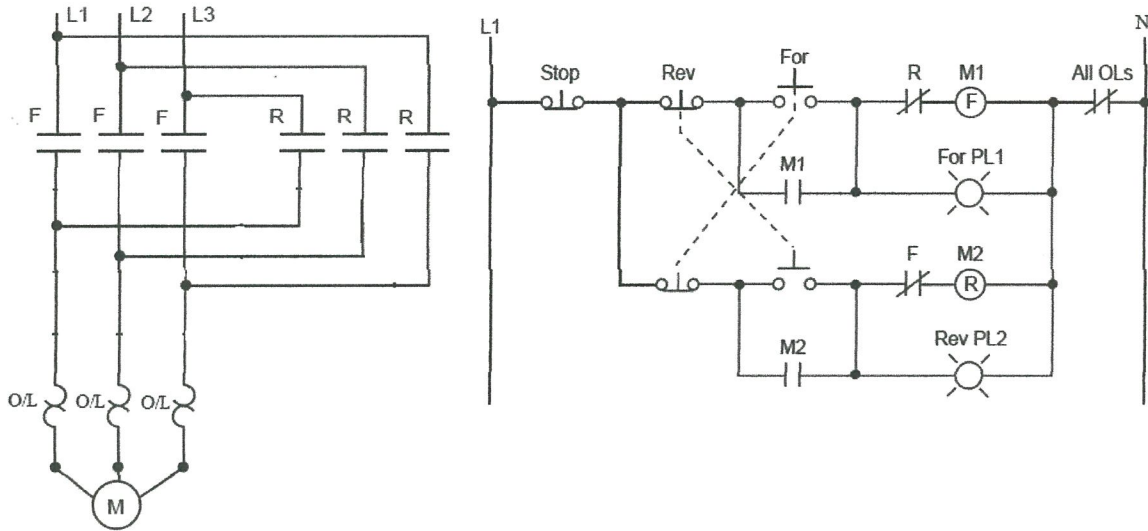


Figure Q3

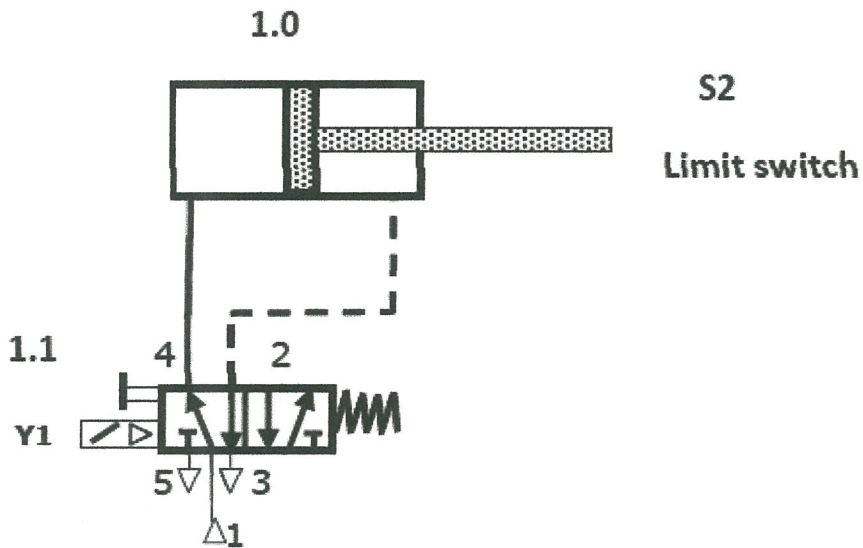


Figure Q4(a)

Faculty of Electrical Engineering  
Universiti Teknikal Malaysia Melaka  
76100 Durian Tunggal, Melaka