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**UNIVERSITI TUN HUSSEIN ONN
MALAYSIA**

**FINAL EXAMINATION
SEMESTER II
SESSION 2017/2018**

COURSE NAME : INDUSTRIAL ELECTRONICS
COURSE CODE : DAE 32003
PROGRAMME : DAE
EXAMINATION DATE : JUNE / JULY 2018
DURATION : 2 HOURS 30 MINUTES
INSTRUCTION : ANSWER FOUR (4) QUESTIONS ONLY

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THIS QUESTION PAPER CONSISTS OF SEVEN (7) PAGES

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- Q1**
- (a) List out **four (4)** basic types of relays and draw its structure respectively. (4 marks)
- (b) The pressure switch may be designed to make contact either on pressure rise or on pressure fall to suit the relevant requirement condition.
- (i) Explain the operating principle of pressure switch. (2 marks)
- (ii) Draw the symbols of pressure switch for both contact condition. (2 marks)
- (iii) Name any **two (2)** types of pressure switch in term of their structure. (2 marks)
- (c) There are **two (2)** outputs, 01005 and 01007. After input 00000 is closed, the output 01005 will be on for 5 seconds. After 5 seconds, output 01005 will be off. Simultaneously, the output 01007 will be on for another 5 seconds and then off.
- (i) Sketch the equivalent ladder diagram of the system. (7 marks)
- (ii) Write out the mnemonic code for the system. (8 marks)
- Q2**
- (a) State the characteristics of an ideal op-amp. (3 marks)
- (b) Derive the output voltage (V_{out}) and gain (A_v) for the op-amp circuit shown in **Figure Q2(b)**. (5marks)
- (c) For the circuit in **Figure Q2(c)**:
- (i) Calculate the output voltage if $R_1 = 1 \text{ k}\Omega$, $R_2 = 2 \text{ k}\Omega$, $R_3 = 4 \text{ k}\Omega$, $R_f = 1 \text{ k}\Omega$, $V_1 = 5 \text{ V}$, $V_2 = 2 \text{ V}$, $V_3 = 1 \text{ V}$. (5 marks)
- (ii) Briefly explain the application of this circuit. (4 marks)
- (d) Given an integrator amplifier as shown in **Figure Q2(d)**. Sketch and label the output signal V_{out} for V_{in} that is 0.5 kHz square wave with a peak voltage of $\pm 5 \text{ V}$ ($10V_{p-p}$). (8 marks)

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Q3 (a) State **five (5)** components or structure of ladder diagram. (5 marks)

(b) Ladder diagram can represents any digital logic functions. Express the equivalent ladder diagram for the following logic operation.

(i) NAND logic (2 marks)

(ii) XOR logic (3 marks)

(c) Based on the following mnemonic code, convert each instructions to the corresponding ladder diagram.

(i)

Address	Instruction	Operands
00000	LD	00000
00001	AND NOT	00001
00002	OR	00002
00003	OUT	01004
00004	END	

(3 marks)

(ii)

Address	Instruction	Operands
00000	LD	00000
00001	TIM	003
00002		#060
00003	LD	TIM 003
00004	OUT	01000
00005	END	

(4 marks)

(iii)

Address	Instruction	Operands
00000	LD	00010
00001	LD	00011
00002	OR	00012
00003	LD	00013
00004	AND	00014
00005	AND	
00006	LD	00015
00007	CNTR(012)	004
00008		#50
00009	LD	CNTR 004
00010	OUT	01001
00011	END	

(8 marks)

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- Q4** (a) Discuss the differences of the following PLC instructions.
- (i) CNT and CNTR(012) (2 marks)
 - (ii) DIFU(13) and DIFD(14) (2 marks)
 - (iii) MOV(21) and KEEP(11) (2 marks)
- (b) Sketch the corresponding ladder diagram for timer in realizing the Off-Delay condition. Assume the PB1 as a single input for the circuit. (4 marks)
- (c) In industrial automation, the consumption of electromechanical component produces a vast potential application. **Figure Q4(c)** shows an example of electro-hydraulic circuit to operate a predefined task.
- (i) List the components used in the circuit. (5 marks)
 - (ii) Explain the operation of the circuit. (7 marks)
 - (iii) Discuss a real application of the circuit in the industry. (3 marks)
- Q5** (a) State **three (3)** types of DC motor. (3 marks)
- (b) A DC motor can be controlled to rotate either clockwise (cw) or counter-clockwise (ccw).
- (i) Name the circuit to control motor rotation. (1 mark)
 - (ii) Sketch the circuit to control the motor. (4 marks)
 - (iii) Discuss the operation of the circuit. (5 marks)

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- (c) A DC chopper circuit converts fixed DC voltage supply to a variable DC voltage.
- (i) Sketch the DC chopper circuit. (6 marks)
 - (ii) A 110 hp DC motor rated 200 A is operating in a chopper circuit from a 500 Vdc source. The armature and field inductance is 0.06H, at the minimum ratio $t_1 / (t_1 + t_2)$ of 0.20. Find the pulse frequency to limit the amplitude of armature current excursion to 10 A. (4 marks)
 - (iii) Predict what happens when a DC motor is connected to a DC chopper circuit. (2 marks)

- Q6** (a) Stepper motor has three modes of operation, full step, half step and microstep.
- (i) Discuss the difference between full step 1-phase ON and full step 2-phase ON. (4 marks)
 - (ii) Illustrate the signal diagram of a 2-phase motor during half step operation. (10 marks)
 - (iii) Explain which operation mode is the most suitable for printing application. (2 marks)
- (b) Calculate the resolution of 4-phase hybrid stepper motor with a 1.8° step angle if the stepper motor operated in :
- (i) Full step. (2 marks)
 - (ii) Half step. (2 marks)
- (c) **Figure Q6(c)** shows a type of solenoid valve. **TERBUKA**
- (i) State the valve type. (2 marks)
 - (ii) Identify the type of ports associated the numbers 1, 2 and 3 marked on the valve as per DIN ISO 5599 standard. (3 marks)

- END OFQUESTION -

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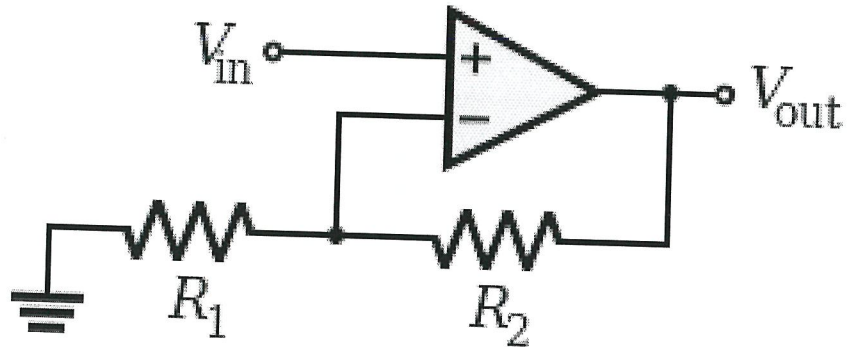


Figure Q2(b)

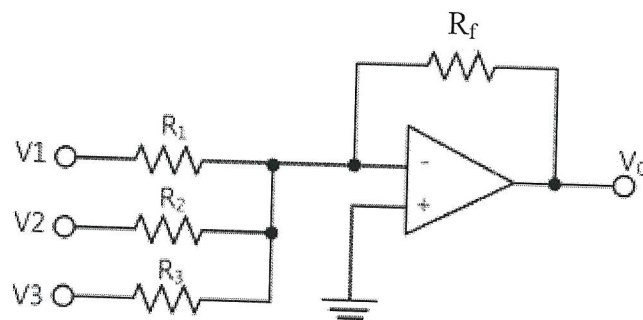


Figure Q2(c)

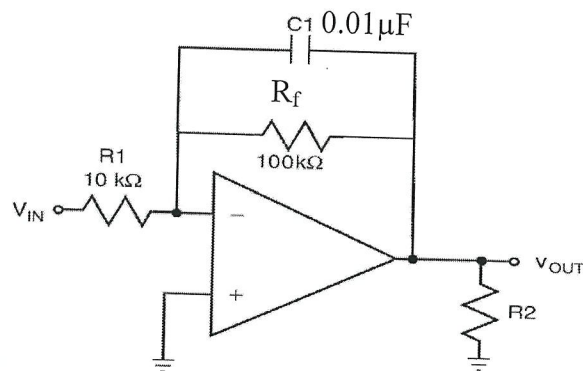


Figure Q2(d)

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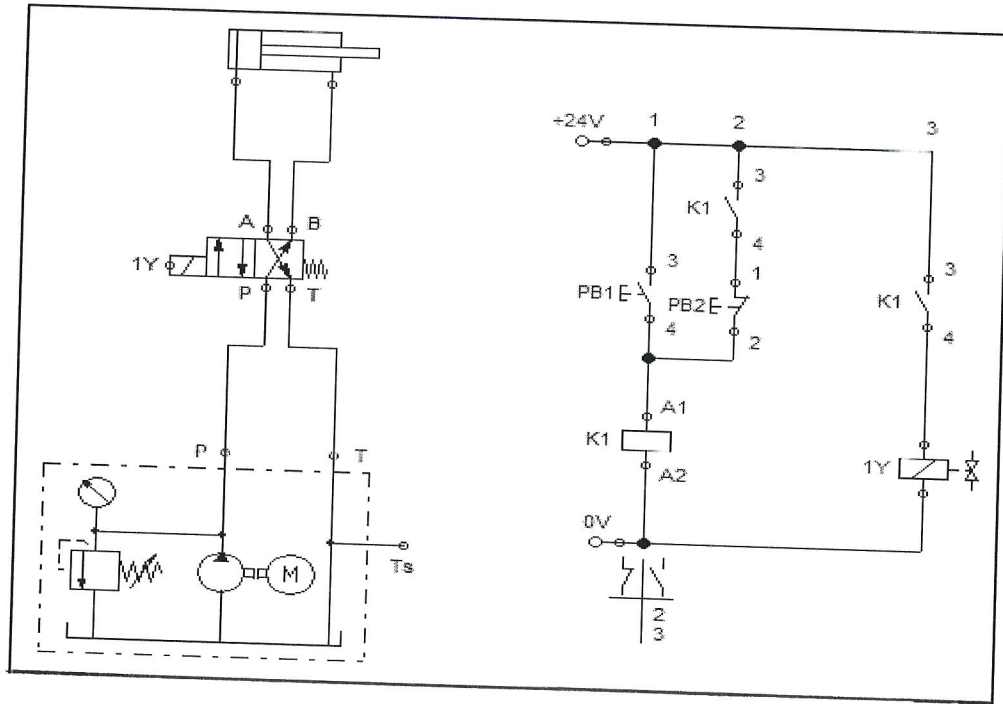


Figure Q4(c)

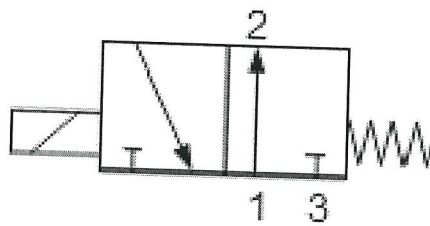


Figure Q6(c)

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