



北京工业大学北京 – 都柏林国际学院
BEIJING-DUBLIN INTERNATIONAL COLLEGE AT BJUT

SEMESTER 2 EXAMINATIONS

ACADEMIC YEAR 2020/2021

EEEN1002J Introduction to Electronic Systems

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BJUT Student ID: _____ **UCD Student ID:** _____

I have read and clearly understand the Examination Rules of both Beijing University of Technology and University College Dublin. I am aware of the Punishment for Violating the Rules of Beijing University of Technology and/or University College Dublin. I hereby promise to abide by the relevant rules and regulations by not giving or receiving any help during the exam. If caught violating the rules, I accept the punishment thereof.

Honesty Pledge: _____ **(Signature)**

Time Allowed: 2 HOURS

Instructions for Candidates

This examination paper contains **FOUR** questions.

Answer any **THREE** questions for a maximum of 300 marks.

All four questions carry equal marks.

The distribution of marks for the parts of each question is indicated in () brackets

Instructions for Invigilators

Non-programmable calculators are permitted.

No rough-work paper is to be provided for candidates.

Q 1

- a. Copy Table 1 into your answer book and complete it. (18 marks)

Table 1: Table of quantities used in circuit theory along with their units, unit symbol, and symbol.

Voltage	Current	Power	Charge
		Watts	
		W	
		p	

- b. Three resistances, R_1 , R_2 , and R_3 , are connected in series. Prove that the total resistance of those resistors is equal to the sum of all the individual resistances. Name any laws of circuit theory that you use. (You may not use the fact that resistances in series add because that is what you are trying to prove.) (30 marks)

- c. Consider Fig. 1. Redraw the circuit in your answer book.

- Label all of the nodes.
- Label all of the branch voltages.
- Label all of the branch currents.
- Find the voltage across R_1 .
- Solve for the current through R_3 . Show your work.

(32 marks)

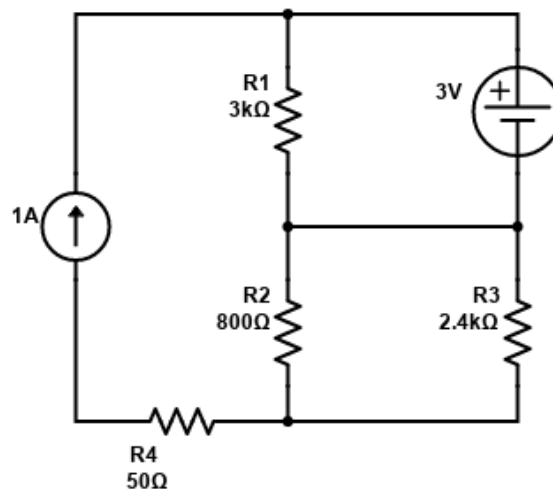


Figure 1: Circuit for part (c).

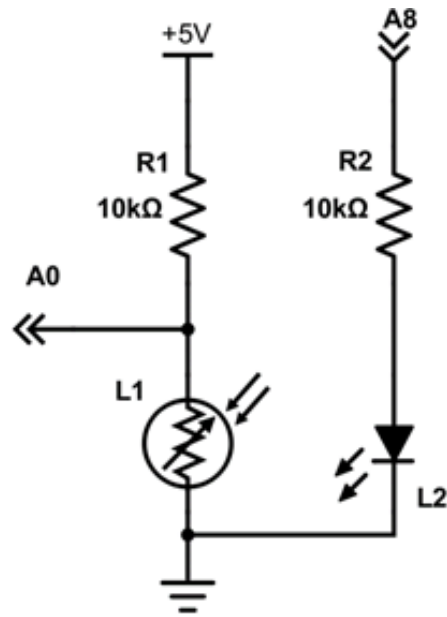


Figure 2: Circuit for part (d).

d.

- i Explain the operation of the circuit in Fig. 2.
- ii What would happen if R1 were changed to be 20 kΩ?

(20 marks)

(Total: 100 marks)

Q 2**a.**

- i AND gates and OR gates are two examples of what kind of gates?
- ii Evaluate the output of the Boolean operation $r = 1.0$.
- iii What does it mean to say that Boolean algebra is commutative?
- iv State De Morgan's Laws.

(20 marks)

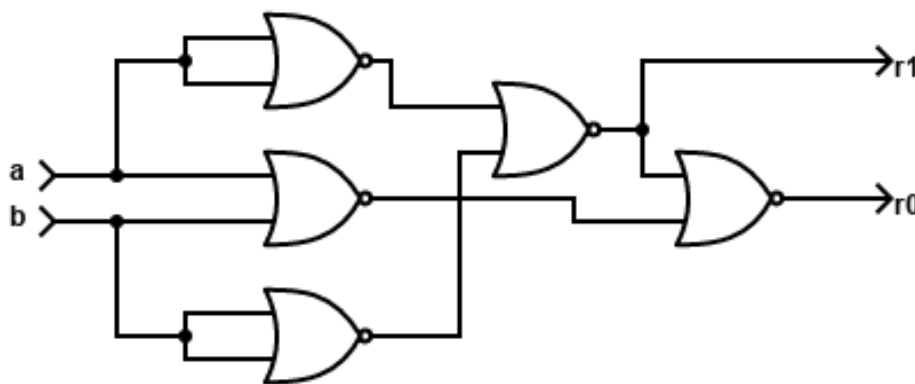


Figure 3: Circuit for part (b).

b. Consider the Boolean logic circuit in Fig. 3. a and b are two 1-bit binary inputs. $r0$ and $r1$ are the bits of a single 2-bit binary output. Every gate in this circuit is made with a NOR gate. There are advantages in manufacturing integrated circuits with only one type of gate.

- i Find a minimal Boolean expression for $r1$.
- ii Fill out Table 2.

(30 marks)

Table 2: Truth table for Q2(b).

a	b	$r0$	$r1$
0	0		
0	1		
1	0		
1	1		

c. Given the following truth table (Tab. 3), find an expression for r . (20 marks)

Table 3: Truth table for Q2(c).

a	b	c	r
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	0

- d. Write a note on the evolution of computing in the 20th century (between 1900 and 1999). Suggested length: 10 sentences. (30 marks)

(Total: 100 marks)

Q 3

- a. Using the ASCII table at the back of this exam paper, determine the 8-bit binary numbers a computer would store to represent the string “Hut”. (15 marks)
- b. Encrypt the file from part (a) using the one-time pad 10000001 00001111 11111100. (15 marks)
- c. Imagine you must encrypt a second message. Could you use the same key? Justify your answer. (15 marks)
- d. Compare and contrast the security and convenience of a one-time pad with PGP. (15 marks)
- e. Explain with the aid of diagrams how digital images store a picture. Your answer should include the camera sensor, resolution, dynamic range, and colour. (40 marks)

(Total: 100 marks)

Q 4**a.**

- i In a telegraph system, how is a message transmitted? When and why does this require a relay? What is the consequence for undersea cables? How was that problem solved?
- ii The first telephone exchange in China was opened in 1882. What is a telephone exchange and why do we use them?
- iii The first television broadcast in China was in 1958. What does the term “broadcast” mean in telecommunications?

(20 marks)

b.

- i Given a message that is comprised of N frames, and each frame has a probability p that a frame will be sent successfully, show that the average transmit time is N/p multiplied by the time required to transmit one frame.
- ii What are the consequences of that result?

(30 marks)

c. Tab. 4 shows an example of an interleaved parity check.

- i Has this signal been transmitted correctly? Justify your answer.
- ii Describe an alternative approach to error checking.

(30 marks)

Table 4: Interleaved parity check for Q4(c).

1	0	1	1
0	0	0	1
1	1	1	0
1	0	0	1
<hr/>			
0	0	1	1

d. The message sequence chart in Fig. 4 describes the behaviour of a communication system. Consider the figure, and answer the questions below.

- i Describe the sequence of events in the diagram.
- ii What is the next message in the sequence?

(20 marks)

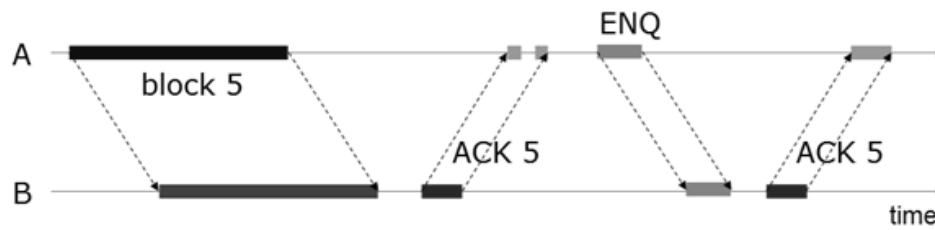


Figure 4: Message sequence for Q4(d).

(Total: 100 marks)

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	0 ^@ NUL NULL	1 ^A SOH START OF HEADING	2 ^B STX START OF TEXT	3 ^C ETX END OF TEXT	4 ^D EOT END OF TRANSM.	5 ^E ENQ ENQUIRY	6 ^F ACK ACKNOWL- EDGE	7 ^G BEL BELL	8 ^H BS BACKSP.	9 ^I HT CHARACT. TAB'TION	10 ^J LF LINE FEED	11 ^K VT LINE TAB'TION	12 ^L FF FORM FEED	13 ^M CR CARRIAGE RETURN	14 ^N SO SHIFT OUT	15 ^O SI SHIFT IN
1	16 ^P DLE DATALINK ESCAPE	17 ^Q DC1 DEVICE CONTROL1	18 ^R DC2 DEVICE CONTROL2	19 ^S DC3 DEVICE CONTROL3	20 ^T DC4 DEVICE CONTROL4	21 ^U NAK NEG. ACK- NOWLEDGE	22 ^V SYN SYNCHR. IDLE	23 ^W ETB END OF TRANS.	24 ^X CAN CANCEL	25 ^Y EM END OF MEDIUM	26 ^Z SUB SUBS- TITUTE	27 ^[ESC ESCAPE	28 ^\ FS INFO. SEP. 4	29 ^] GS INFO. SEP. 3	30 ^^ RS INFO. SEP. 2	31 ^_ US INFO. SEP. 1
2	 SPACE	! excl ! EXCLAM. MARK	" quot " QUOT. MARK	# num # NUMBER SIGN	$ dollar \$ DOLLAR SIGN	% percnt % PERCENT SIGN	& amp & AMPER- SAND	' apos ' APOS- TROPHE	(lpar (LEFT PAREN.	) rpar) RIGHT PAREN.	* ast * ASTERISK	+ plus + PLUS SIGN	, comma , COMMA	- - HYPHEN- MINUS	. period . FULL STOP	/ sol / SOLIDUS
3	0 DIGIT ZERO	1 DIGIT ONE	2 DIGIT TWO	3 DIGIT THREE	4 DIGIT FOUR	5 DIGIT FIVE	6 DIGIT SIX	7 DIGIT SEVEN	8 DIGIT EIGHT	9 DIGIT NINE	: colon : COLON	; semi ; SEMI- COLON	< lt < LS.-THAN SIGN	= equals = EQUALS SIGN	> gt > GR.-THAN SIGN	? quest ? QUEST- ION MARK
4	@ commat @ COMM'IAL AT	A A	B B	C C	D D	E E	F F	G G	H H	I I	J J	K K	L L	M M	N N	O O
5	P P	Q Q	R R	S S	T T	U U	V V	W W	X X	Y Y	Z Z	[lsqb [LEFT SQ. BRACKET	\ bsol \ REVERSE SOLIDUS	] rsqb] RT. SQ. BRACKET	^ hat ^ CIRCUM'X ACCENT	_ lowbar _ LOW LINE
6	` grave ' GRAVE ACCENT	a a	b b	c c	d d	e e	f f	g g	h h	i i	j j	k k	l l	m m	n n	o o
7	p p	q q	r r	s s	t t	u u	v v	w w	x x	y y	z z	{ {	| 	} }	~ ~	&#127; ^? DEL DELETE

ASCII code table including entity references, control codes and Unicode names (1.1) Tom Gibara July 2014

Figure 5: ASCII Table for Q3(a).