



COLLEGE OF ENGINEERING, SCIENCE AND TECHNOLOGY  
SCHOOL OF ELECTRICAL AND ELECTRONIC ENGINEERING

TRADE DIPLOMA PROGRAMME

EEE543 DIGITAL & ANALOGUE ELECTRONICS

**FINAL EXAMINATION (TRIMESTER 1, 2017)**

DATE/TIME/ROOM – Refer to Exam Timetable

**INSTRUCTIONS TO CANDIDATES**

1. You are allowed 10 minutes extra time during which you are not to write.
2. Write all your answers in the allocated Answer Booklet.
3. Begin each answer on a fresh new page and use both sides of the sheets.
4. Write your identification number on the top of each attached sheet.
5. Insert all written foolscaps, graph paper, drawing paper, etc in their correct sequence and secure with string provided.
6. For all sheets of paper in which has been done, cross it through and you must attach to your answer script.
7. Write clearly the number(s) of the question(s) attempted on the top of each sheet.
8. GSM or Smartphones or digital numbering calculators are prohibited to be used during this examination.
9. There are 5 Sections in this Exam Paper that are compulsory.

4

4

**Section A:**

**Multiple Choice**

**(20 marks)**

**Instructions:**

Choose the answer by circling the correct alphabet as per answer sheet (Appendix 1) that is attached to the question. Attach appendix 1 to the answer booklet. (1 mark for each correct answer)

1. The movement of the second hand on a clock is classified as:
  - a) Discrete
  - b) Finite
  - c) Analogue technique
  - d) Digital technique
2. Which logical gate gives a logic 1 output when the inputs to this gate is similar?
  - a) AND gate
  - b) EXOR gate
  - c) EXNOR gate
  - d) OR gate
3. A high logic when measured at the output of any LS logical gate is:
  - a) 2.0 V – 5.0 V
  - b) 5.0 V
  - c) 2.7 V – 5.0V
  - d) 2.6V – 5.0V
4. Name the flipflop that has only one input beside the clock input:
  - a) SR NOR flipflop
  - b) SR NAND flipflop
  - c) Delay Flipflop
  - d) None of the above
5. Determine the SOP Boolean equation of the given truth table:

		A	
		0	1
B	0	0	1
	1	0	1

- a)  $\bar{A}$
- b)  $A + \bar{B}$
- c)  $A$
- d)  $B$



6.  $111_2 + 3_{10} = \underline{\hspace{2cm}}_8$
- $1010_8$
  - $12_8$
  - $1001_8$
  - $11_8$
7. If two mechanical switches are open and connected in series with a lamp and a battery. Which logical gate best describes this setup.
- OR gate
  - XOR gate
  - AND gate
  - NAND gate
8. A DVD disk is considered as a:
- Analogue device.
  - Analogue to digital device
  - Digital to analogue device
  - Digital device
9. Which alphanumerical characters are valid for Octal numbering systems?
- 3, 4, 5, 6, 7, 8, & 9
  - G – Z
  - 0, 1, 2, 3, 4, 5, 6 & 7
  - None of the above
10. Name the reflective codes:
- ASCII codes
  - EBCDIC codes
  - BCD codes
  - Gray codes
11. A shorted NAND inputs will be equivalent to          gate.
- NAND
  - OR
  - INVERTER
  - NOR
12.  $1EF_{16} = \underline{\hspace{2cm}}_2$
- 1110111
  - 11110111
  - 111101111
  - 111100111



13. ASCII coding represents a \_\_\_\_\_ bit code

- a) 1024
- b) 8
- c) 6
- d) 7

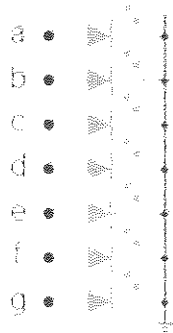
14. What is De Morgan's theorem?

- a)  $\overline{F \cdot G} = \overline{F} + \overline{G}$
- b)  $\overline{F \cdot G} = \overline{F} \overline{G} + \overline{HG}$
- c)  $\overline{F \cdot G} = \overline{F} + (\overline{G} \overline{G})$
- d) All of the above

15. Which digital IC family presents 4xxx series?

- a) CMOS
- b) RTL
- c) DTL
- d) TTL

16. Identify the Seven Segment Display connection configuration as illustrated below:



- a) Common Anode
- b) Parallel Cathode
- c) Common Cathode
- d) Grounded Anode

17. The \_\_\_\_\_ has both the analog – to – digital converter and digital – to – analog converter.

- a) Seven segment display
- b) MODEM
- c) Light emitting diode
- d) Capacitor





18. What's the purpose of the rectifier in any DC power supply unit?
- a) Stabilize the DC component of the voltage
  - b) Change AC into pulsating DC
  - c) Change AC into DC
  - d) Both b) and c)
19. The output voltage of a LM 7905 DC regulator is:
- a) +5 Volts
  - b) 905 Volts
  - c) - 5 Volts
  - d) 79 Volts
20. If the operation amplifier has a voltage gain 4 with a input voltage of 2 V, then what is its output voltage:
- a) 6 V
  - b) 8 V
  - c) 2 V
  - d) 0 V



**Section B**

**(Designing, Analyzing, Operating & Calculating)**

**(80 Marks)**

Instructions:

Use the answer booklet to answer the questions

Question 1:

Construct a truth table for the following conditions.

- i) there are three buttons A, B, C.
- ii) the output is on if any two buttons are pushed.
- iii) if C is pressed the output will always turn on.

- a) Develop a Boolean SOP expression by using a truth table. (8 marks)
- b) Develop a Boolean SOP expression using a Karnaugh map. (8 marks)
- c) Illustrate a combinational logic diagram for the minimised Boolean SOP expression. (4 marks)

Question 2:

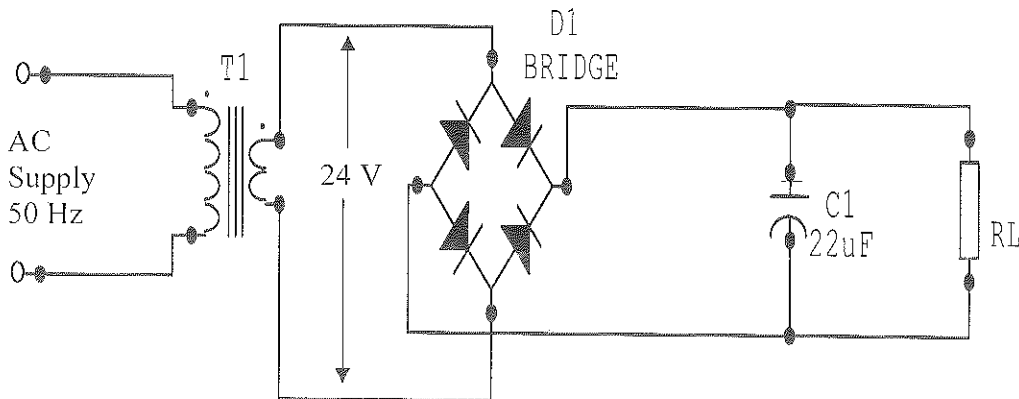
Part A

Design and label the block diagram of a +5V DC power supply unit. Explain its operations with the aid of waveforms and its circuit diagram.

(12 marks)

Part B

For the given circuit as given below, determine the following:



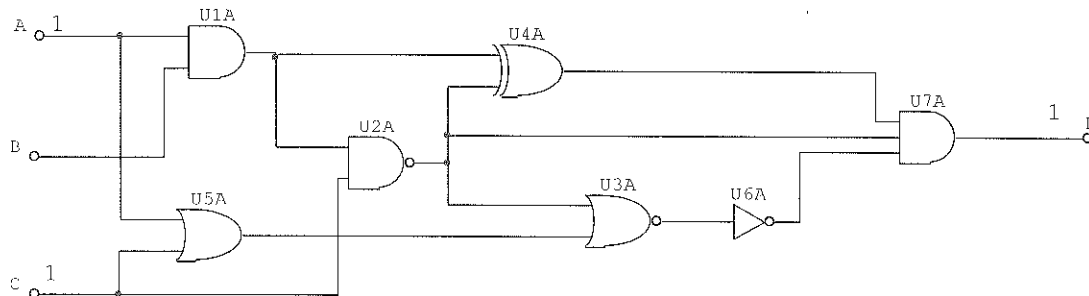
- (i) No load DC output voltage. (2 marks)
- (ii) Average DC load voltage when the load is 3.3 k $\Omega$ . (4 marks)
- (iii) Average DC load voltage when the load is 1 k $\Omega$ . (2 marks)



Question 3:

Part A

Determine the missing logics of each gate output and input B except U7A, input A and input C; of the given combinational logic diagram.



(7 marks)

Part B

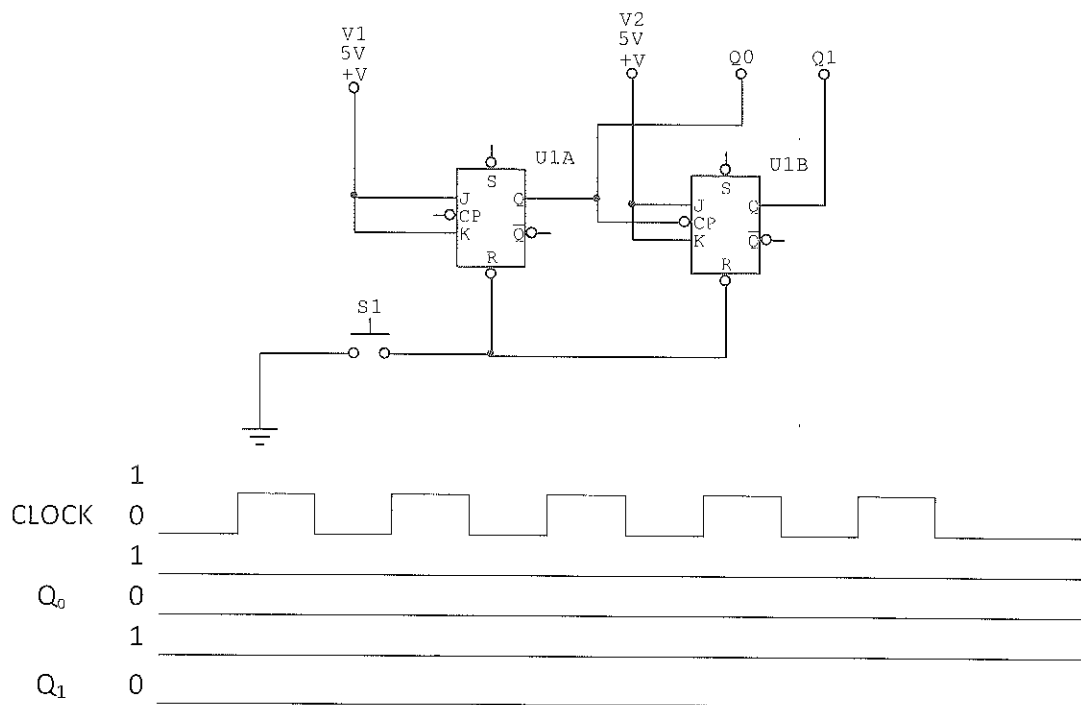
Draw a dual-in-line package Transistor Transistor Logic (TTL) Integrated Circuit (IC) and label its pin number. Indicate the how pin 1 is identified.

(3 marks)

Part C

Using the attached timing diagram sheet in *Appendix 4*, determine the output waveforms of the Asynchronous Counter Logic Circuit by considering the clock input as a negative edge trigger. (Attach *Appendix 2* to the answer booklet)

(10 marks)





#### Question 4

##### Part A

Determine the equivalence of the following numbering systems by using your own methods:

- (i)  $254_{10} = \underline{\hspace{2cm}}_2$  (2 marks)
- (ii)  $342_8 = \underline{\hspace{2cm}}_{16}$  (3 marks)
- (iii)  $1111_2 + 13_{10} = \underline{\hspace{2cm}}_8$  (5 marks)

##### Part B

Using the datasheets in appendix 3, determine the following:

- (i) The current ratings of the LM117 adjustable regulator integrated circuit and indicate its output voltage. (1 mark)
- (ii) The input voltage of a fixed regulator LM123 integrated circuit (3 marks)
- (iii) What is the typical supply voltage of the SN74LS00? (1 mark)
- (iv) What is the DC current gain of the bipolar junction transistor type BC548C? (1 mark)
- (v) Determine the maximum base current of the bipolar junction transistor type BC547 when the collector current is 2mA? (3 marks)
- (vi) What is the maximum noise figure of the bipolar junction type BC546? (1 mark)





## Appendix 1

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Student's ID#: \_\_\_\_\_

### Section A

1	A	B	C	D
2	A	B	C	D
3	A	B	C	D
4	A	B	C	D
5	A	B	C	D
6	A	B	C	D
7	A	B	C	D
8	A	B	C	D
9	A	B	C	D
10	A	B	C	D
11	A	B	C	D
12	A	B	C	D
13	A	B	C	D
14	A	B	C	D
15	A	B	C	D
16	A	B	C	D
17	A	B	C	D
18	A	B	C	D
19	A	B	C	D
20	A	B	C	D



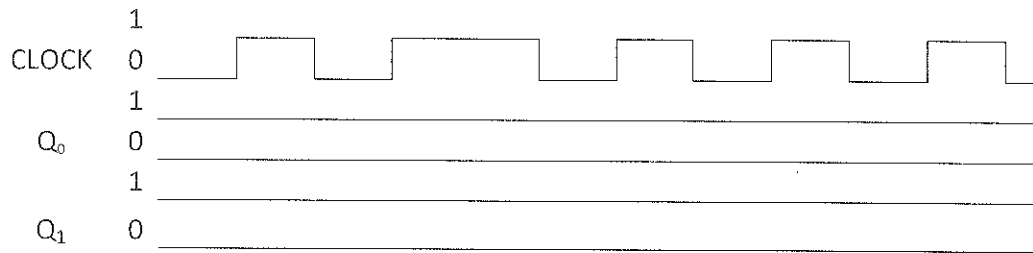
## Appendix 2

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Student's ID#: \_\_\_\_\_

### Section B

#### Question 2 Part C:



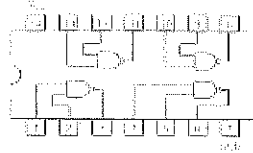


# Appendix 3

## SN74LS00

### Quad 2-Input NAND Gate

1.1.1.1.1.1.1.1.1.1



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LOW  
POWER  
SCHOTTKY

#### GUARANTEED OPERATING RANGE:

Symbol	Parameter	Min	Typ	Max	Notes
V <sub>CC</sub>	Supply Voltage	0.7V	5V	7.0V	1
V <sub>OL</sub>	Open-Drain Output Transistor Voltage	0	0.1	0.1	1
I <sub>OL</sub>	Collector Current - High			10.0	2
I <sub>OL</sub>	Collector Current - Low			10.0	2



PLCC  
U SUPPLY  
GND GND

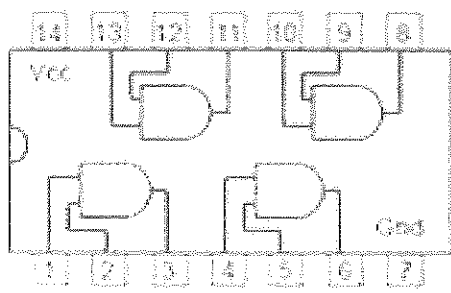


SOIC  
U SUPPLY  
GND GND

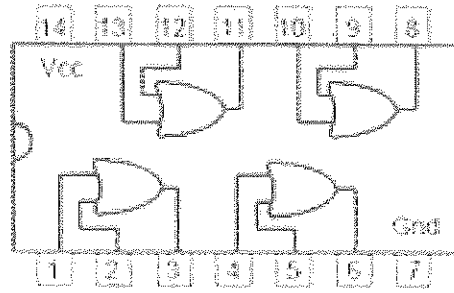
#### ORDERING INFORMATION

Device	Package	Shipping
SN74LS00	14-Pin DIP	20K (Tape & Reel)
SN74LS00	14-Pin	25K (Tape & Reel)

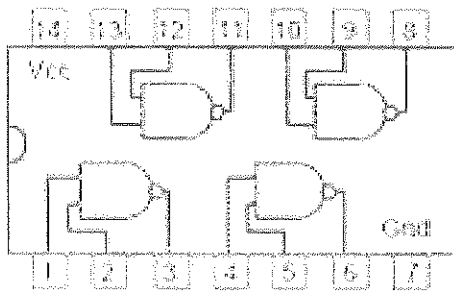




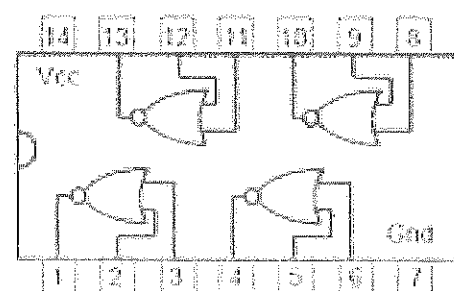
7408 Quad 2 input  
AND Gates



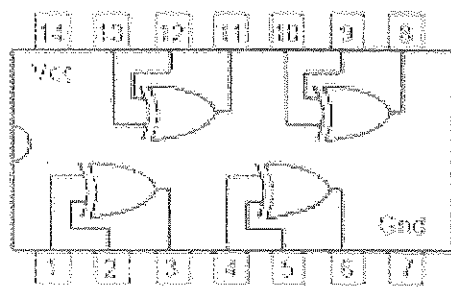
7432 Quad 2 input  
OR Gates



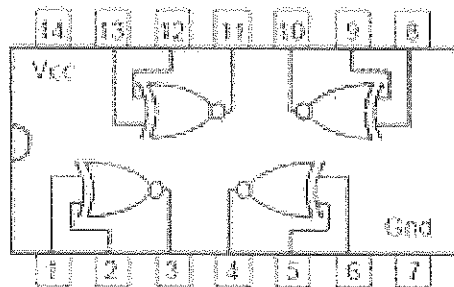
7400 Quad 2 input  
NAND Gates



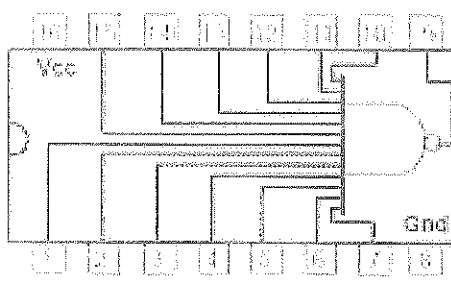
7402 Quad 2 input  
NOR Gates



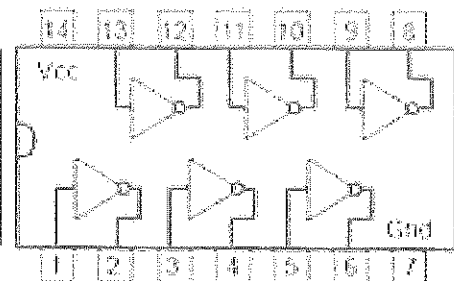
7486 Quad 2 input  
XOR Gates



747266 Quad 2 input  
XNOR Gates



74133 Single 13 input  
NAND Gate



7404 Hex NOT Gates  
(Inverters)





**BC546, B BC547, A, B, C BC548, A, B, C**

ELECTRICAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$  unless otherwise noted) (Continued)

Characteristic	Symbol	Min	Typ	Max	Unit
<b>ON CHARACTERISTICS</b>					
DC Current Gain ( $I_C = 10\text{ mA}$ , $V_{CE} = 5.0\text{ V}$ )	$h_{FE}$	—	90	—	—
	BC547A/548A	—	150	—	—
	BC546B/547B/548B	—	270	—	—
	BC548C	—	—	—	—
( $I_C = 1.0\text{ mA}$ , $V_{CE} = 5.0\text{ V}$ )	BC546	110	—	450	—
	BC547	110	—	500	—
	BC548	110	—	500	—
	BC547A/548A	110	180	220	—
	BC546B/547B/548B	200	290	450	—
	BC547C/548C	420	620	900	—
( $I_C = 100\text{ mA}$ , $V_{CE} = 5.0\text{ V}$ )	BC547A/548A	—	120	—	—
	BC546B/547B/548B	—	180	—	—
	BC548C	—	300	—	—
Collector-Emitter Saturation Voltage ( $I_C = 10\text{ mA}$ , $I_B = 0.5\text{ mA}$ ) ( $I_C = 100\text{ mA}$ , $I_B = 5.0\text{ mA}$ ) ( $I_C = 10\text{ mA}$ , $I_B = \text{See Note 1}$ )	$V_{CE(sat)}$	—	0.02	0.25	V
		—	0.2	0.6	
		—	0.3	0.8	
Base-Emitter Saturation Voltage ( $I_C = 10\text{ mA}$ , $I_B = 0.5\text{ mA}$ )	$V_{BE(sat)}$	—	0.7	—	V
Base-Emitter On Voltage ( $I_C = 2.0\text{ mA}$ , $V_{CE} = 5.0\text{ V}$ ) ( $I_C = 10\text{ mA}$ , $V_{CE} = 5.0\text{ V}$ )	$V_{BE(on)}$	0.56	—	0.7	V
		—	—	0.77	

**SMALL-SIGNAL CHARACTERISTICS**

Current-Gain — Bandwidth Product ( $I_C = 10\text{ mA}$ , $V_{CE} = 5.0\text{ V}$ , $f = 100\text{ MHz}$ )	$f_T$	150	300	—	MHz
		150	300	—	
		150	300	—	
Output Capacitance ( $V_{CE} = 10\text{ V}$ , $I_C = 0$ , $f = 1.0\text{ MHz}$ )	$C_{ob}$	—	1.7	4.5	pF
Input Capacitance ( $V_{BE} = 0.5\text{ V}$ , $I_C = 0$ , $f = 1.0\text{ MHz}$ )	$C_{ib}$	—	10	—	pF
Small-Signal Current Gain ( $I_C = 2.0\text{ mA}$ , $V_{CE} = 5.0\text{ V}$ , $f = 1.0\text{ kHz}$ )	$h_{fe}$	125	—	500	—
	BC546	125	—	500	—
	BC547/548	125	—	500	—
	BC547A/548A	125	220	360	—
	BC546B/547B/548B	240	320	500	—
	BC547C/548C	450	600	900	—
Noise Figure ( $I_C = 0.1\text{ mA}$ , $V_{CE} = 5.0\text{ V}$ , $R_G = 2\text{ k}\Omega$ ) ( $f = 1.0\text{ kHz}$ , $\Delta f = 200\text{ Hz}$ )	NF	—	2.0	10	dB
	BC546	—	2.0	10	
	BC547	—	2.0	10	
	BC548	—	2.0	10	



ADJUSTABLE REGULATORS (+VE CURRENT OUTPUT)			
amps	device	Output voltage	Package
10	LM196	1.25 – 15	TO – 3
	LM396	1.25 – 15	TO – 3
5	LM138	1.2 – 32	TO – 3
	LM238	1.2 – 32	TO – 3
	LM338	1.2 – 32	TO – 3
3	LM150	1.2 – 33	TO – 3
	LM250	1.2 – 33	TO – 3
	LM350	1.2 – 33	TO – 3, TO – 220
1.5	LM117	1.2 – 37	TO – 3
	LM117HV	1.2 – 57	TO – 3
	LM217	1.2 – 37	TO – 3
	LM217HV	1.2 – 57	TO – 3
	LM317	1.2 – 37	TO – 3, TO – 220
	LM317HV	1.2 – 57	TO – 3
0.5	LM117H	1.2 – 37	TO – 39
	LM117HVH	1.2 – 57	TO – 39
	LM217H	1.2 – 37	TO – 39
	LM317HVH	1.2 – 37	TO – 39
	LM317M	1.2 – 37	TO – 202
0.1	LM317L	1.2 – 37	TO – 92



ADJUSTABLE REGULATORS (-VE CURRENT OUTPUT)			
amps	device	Output voltage	Package
3	LM133	-1.2 – -27	TO – 3
	LM333	-1.2 – -27	TO – 3, TO – 220
	LM333A	-1.2 – -27	TO – 3
1.5	LM137	-1.2 – -37	TO – 3
	LM137HV	-1.2 – -47	TO – 3
	LM237	-1.2 – -37	TO – 3
	LM237HV	-1.2 – -47	TO – 3
	LM337	-1.2 – -37	TO – 3, TO – 220
	LM337HV	-1.2 – -47	TO – 3
0.5	LM137	-1.2 – -37	TO – 39
	LM137HVH	-1.2 – -47	TO – 39
	LM237H	-1.2 – -37	TO – 39
	LM337H	-1.2 – -37	TO – 39
	LM337HVH	-1.2 – -47	TO – 39
	LM337M	-1.2 – -37	TO – 202
0.1	LM337L	-1.2 – -37	TO – 92



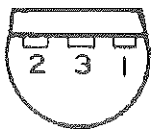
FIXED REGULATORS (+VE CURRENT OUTPUT)			
amps	device	Output voltage	Package
3	LM123	5	TO - 3
	LM223	5	TO - 3
	LM323	5	TO - 3
1.5	LM109	5	TO - 3
	LM209	5	TO - 3
	LM309	5	TO - 3
	LM140	5, 12, 15	TO - 3
	LM140A	5, 12, 15	TO - 3
	LM340	5, 12, 15	TO - 3, TO - 220
	LM340A	5, 12, 15	TO - 3, TO - 220
	LM78XXC	5, 12, 15	TO - 3, TO - 220
0.5	LM341	5, 12, 15	TO - 220, TO - 202
	LM78MXXC	5, 12, 15	TO - 220
0.2	LM109H	5	TO - 39
	LM209H	5	TO - 39
	LM309H	5	TO - 39
	LM342	5, 12, 15	TO - 202
0.1	LM140LA	5, 12, 15	TO - 39
	LM340L	5, 12, 15	TO - 92, TO - 39
	LM78XXA	5, 12, 15	TO - 92, TO - 39



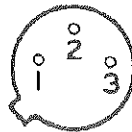


FIXED REGULATORS (-VE CURRENT OUTPUT)			
amps	device	Output voltage	Package
3	LM145	-5, -5.2	TO - 3
	LM345	-5, -5.2	TO - 3
1.5	LM120	-5, -12, -15	TO - 3
	LM320*	-5, -12, -15	TO - 3, TO - 220
	LM79XXC	-5, -12, -15	TO - 3, TO - 220
0.5	LM320M*	-5, -12, -15	TO - 202
	LM79MXXC	-5, -12, -15	TO - 202, TO - 39
0.2	LM120H	-5, -12, -15	TO - 39
	LM320H	-5, -12, -15	TO - 39
0.1	LM320L	-5, -12, -15	TO - 92
	LM79XXAC	-5, -12, -15	TO - 92

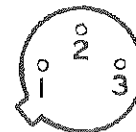
TO - 92(Z)



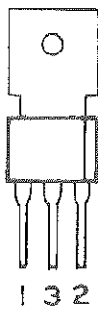
TO - 39(H)



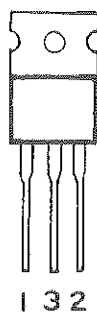
TO - 5(H)



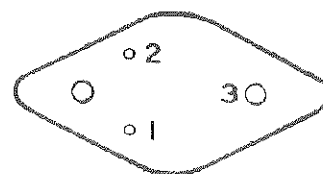
TO - 202(P)



TO - 220(T)



TO - 3(K)





## Blue Print of EEE543: Digital & Analog Electronics

EEE543 is a level 5 unit and in accordance to the FNU's UASR Part VIII Section 1.0 Sub-Section 3.0 under-with 3.1 to 3.5; may I quote; "....."

- Level 1 – (All the action verbs in accordance to FNU's USAR Part VIII, Section 1.0, Sub-Section 3.0, under-with 3.1 concerned with 'knowledge')
- Level 2 – (All the action verbs in accordance to FNU's USAR Part VIII, Section 1.0, Sub-Section 3.0, under-with 3.2 concerned with 'comprehension')
- Level 3 – (All the action verbs in accordance to FNU's USAR Part VIII, Section 1.0, Sub-Section 3.0, under-with 3.3 concerned with 'application')
- Level 4 – (All the action verbs in accordance to FNU's USAR Part VIII, Section 1.0, Sub-Section 3.0, under-with 3.4 concerned with 'application')
- Level 5 – (All the action verbs in accordance to FNU's USAR Part VIII, Section 1.0, Sub-Section 3.0, under-with 3.5 concerned with 'analysis')

Considering the above, the unit EEE543 was taught about the above where students had to explore, apply, and analysis practical case studies referenced to the EEE543 unit descriptor.

Furthermore, the FNU qualification framework was applied in context on the deliverance of the said unit referenced to the unit descriptor and likewise the final examination preparation and development was established to reflect the above based on "knowledge", "comprehension", "application", and "analysis".

Level	Criterion	Section	Question	Unit descriptor	Comments
1	Knowledge	A	1, 2, 9, 10, 12, 13	Topic 1	
			4	Topic 4	
			5	Topic 2	
			15	Topic 5	
			16	Topic 7	
			18	Topic 8	
			19	Topic 9	
2	Comprehension	A	6	Topic 1	
3	Application	A	3, 8, 11	Topic 1	
			17	Topic 6	
4	Application	A	5, 14	Topic 2	
			7	Topic 1 & 2	
5	Analysis	A	20	Topic 11	

Section B Question 1 covers merely Levels 1 to 5 for Topics 1, 2, and 3 based on the student will design, analyse and know its operations on the practical case study. Note the students were trained during the theoretical lectures, tutorials and likewise a project was based on the similar guidelines of this question. This



is enhanced the students to think beyond the horizon in regards to the practical context if one should be in the industry.

Section B Question 2 Part A; reflects on the designing skills a student needs in analysing the simple DC power supply unit theoretical and simply to understand how DC power supplies operate and what parameters or specifications must be obtained when using one. From the EEE543 UD, this is topics 8 and 9. Part B; covers Level 2, 3, 4 and 5 in which a student should compare, check, interpret, apply, calculate and analysis to find the answers.

Section B Question 3 Part A; covers topics 1, 2 and 3 where a student analyses the combinational logic diagram and simply troubleshoots it to locate the answer. The question was covered during the lectures, tutorial and practical exercise as well a practical test where students had to diagnose, analyse and explore to determine the correctness of resolving the answer. Part B; covers Topic 5 where students need to identify the pin numbers of various IC packages however this package was considered as its commonly used in their industrial works. Part C; Covers Topic 4 based on Level 1, 2, 4 and 5 on how flipflops operates, the consideration of flipflop parameters for synchronous and asynchronous operations, truth table analyses of the flipflops, and the asynchronous counter circuit operations and analysis.

Section B Question 4 Part A; covers numbering systems where students should know these principles in regards to reading or decoding the gray codes of a tachometer of any Motor. Decoding of gray codes was thoroughly taught in during the lectures and assignment was given. Part B; covers the interpretations of data sheets which is useful for industrial electrical/electronics for any improvising made for replacements of the electronic components.

