



COLLEGE OF ENGINEERING, SCIENCE & TECHNOLOGY (CEST)

SCHOOL OF ELECTRICAL & ELECTRONICS ENGINEERING

TRADE DIPLOMA IN ELECTRICAL ENGINEERING

(ELECTRICAL AND RENEWABLE ENERGY) – STAGE 3

EEE437- INTRODUCTION TO ELECTRONICS

FINAL EXAMINATION – SEMSTER 2, 2016

**INSTRUCTIONS TO STUDENTS**

1. You are allowed 10 minutes Extra reading time during which you are NOT to write.
2. Begin each answer on a fresh page and use both sides of the sheet.
3. Write your candidate-number at the top of each attached sheet
4. Insert all written foolscaps, graph paper, drawing paper, etc. in their correct sequence and secure with string
5. For all sheets of paper on which rough/draft work has been done, cross it through and you MUST ATTACH to your answer scripts.
6. Write clearly the number(s) of the question(s) attempted on the top of each sheet.
7. ANSWER ALL QUESTIONS.
8. Show all workings where necessary.
9. Do not use programmable calculators.
10. **ALWAYS CHECK YOUR WORK BEFORE YOU LEAVE THE ROOM!**

**Section A****Multiple Choice****[30 Marks]**

Circle correct letter (A, B, C or D) against each of numbers 1 through 30.  
Remove and attach to your Answer Booklet.

- 1. Octal to decimal conversion is carried out by?**
  - A. Finding the sum of the product of each digit times its positional value.
  - B. Converting each digit into its 3-bit binary equivalent.
  - C. Repeatedly dividing the number by eight and noting the remainder.
  - D. Converting each digit into its equivalent BCD code.
  
- 2. Decimal to hexadecimal conversion is carried out by?**
  - A. Finding the sum of the product of each digit times its positional value.
  - B. Converting each digit into its 4-bit binary equivalent.
  - C. Repeatedly dividing the number by sixteen and noting the remainder.
  - D. Converting each digit into its equivalent BCD code.
  
- 3. The ASCII code is?**
  - A. A positional value code.
  - B. A minimum change code.
  - C. An Alphanumeric code.
  - D. A straight binary code.
  
- 4. Which of the following is a forbidden code group in BCD?**
  - A. 0010
  - B. 0101
  - C. 1000
  - D. 1010
  
- 5. An Large Scale Integration (LSI) device has a circuit complexity of**
  - A. 12 to 99 equivalent gates
  - B. 100 to 9999 equivalent gates
  - C. 2000 to 5000 equivalent gates
  - D. 10,000 to 99,999 equivalent gates
  
- 6. A 4 – bit binary counter has a maximum modulus of**
  - A. 16

- B. 32.  
C. 8  
D. 4
7. According to De-Morgan's theorem, which of the following equality(s) are correct?
- A.  $\overline{AB} = \overline{A} + \overline{B}$   
B.  $\overline{XYZ} = \overline{X} + \overline{Y} + \overline{Z}$   
C.  $\overline{A + B + C} = \overline{A} \overline{B} \overline{C}$   
D. all of the above
8. An example of a sum of products expression
- A.  $A + B(C + D)$   
B.  $AB + AC + ABC$   
C.  $(A + B + C)(A + B + C)$   
D. both answers (a) and (b)
9. A 4 – variable Karnaugh map has
- A. eight cells  
B. three cells  
C. sixteen cells  
D. four cells
10. Asynchronous counters are known as
- A. ripple counters  
B. multiple clock counters  
C. decade counters  
D. modulus counters
11. To parallel load a byte of data into a shift register, there must be
- A. one clock pulse  
B. one clock pulse for each 1 in the data  
C. eight clock pulse  
D. one clock pulse for each 0 in the data

12. The group of bits 10110101 is serially shifted (right most bit first) into an 8 bit parallel output shift register with an initial state of 11100100. After two clock pulses, the register contains.
- A. 01011110
  - B. 10110101
  - C. 01111001
  - D. 00101101
13. In a binary-weighted digital to analog converter(DAC), the resistors on the inputs
- A. determine the amplitude of the analog signal
  - B. determine the weights of the digital inputs
  - C. Limit the power consumption
  - D. Prevent loading on the source
14. In an R/2R DAC, there are
- A. four values of resistors.
  - B. One resistor value
  - C. Two resistor values.
  - D. A number of resistor values equal to the number of inputs.
15. An 8-bit DAC has a resolution of
- A. 0.1%
  - B. 0.392%
  - C. 1%
  - D. 3.92%
16. The type of analog-to-digital converter(ADC) with the fastest conversion time is
- A. flash
  - B. digital ramp
  - C. tracking
  - D. simultaneous conversion

17. Which of the following is not a TTL circuit?

- A. 7400
- B. 74S00
- C. 74HC00
- D. 74AS00

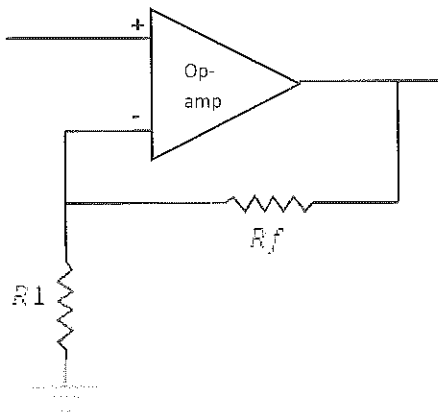
18. Proper handling of a CMOS device is necessary because of its

- A. fragile construction
- B. high noise immunity
- C. susceptibility to electrostatic discharge
- D. lower power dissipation

19. How many layers does a transistor have?

- A. 1
- B. 2
- C. 4
- D. 3

20. Calculate the overall voltage gain of the circuit if  $R_1 = 200\Omega$  and  $R_f = 2k\Omega$



- A. -1
- B. -10
- C. 9
- D. 11

21. What is the slew rate of an op-amp if the output voltages change from 2 V to 3 V in 0.2ms?

- A. 5 V/ms
- B. 3 V/ms
- C. 2 V/ms
- D. 1 V/ms

22. If  $A_v(d) = 250$  and  $A_{cm} = 0.025$ , the CMRR is

- A. 625
- B. 10,000
- C. 80dB
- D. Answer B and C

23. Which of the following pin numbers represent the output terminal of LM741 operational amplifier?

- A. 2
- B. 3
- C. 4
- D. 6

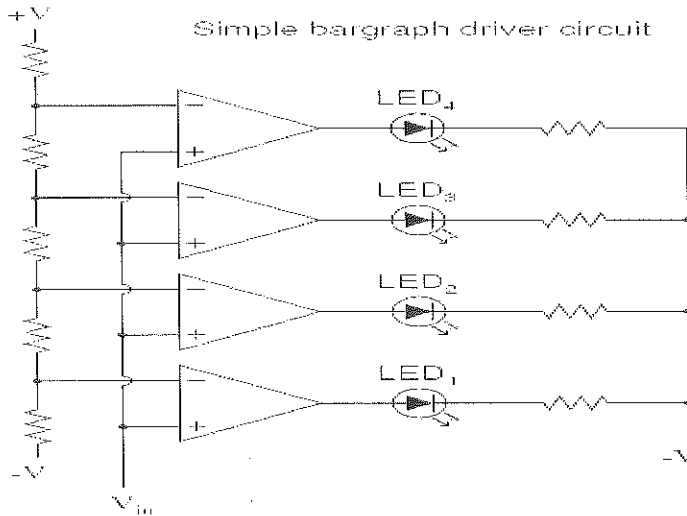
24. In PNP transistor, the P-Region are

- A. Base and emitter
- B. Base and collector
- C. Emitter and collector
- D. Only base

25. If  $I_c$  is 50 times larger than  $I_B$ , then  $\beta$  is

- A. 0.02
- B. 100
- C. 50
- D. 500

26. Which LED will be the *last* one to light up in the circuit?



- A. LED 1
- B. LED 2
- C. LED 3
- D. LED 4

27. BJT is a \_\_\_\_\_ controlled device. The JFET is a \_\_\_\_\_ controlled device

- A. Voltage, voltage
- B. Voltage, Current
- C. Current, Voltage
- D. Current, Current

28. A JFET always operates with

- A. The gate-to-source *pn* junction reversed-biased
- B. The gate-to-source *pn* junction forward-biased
- C. The drain connected to ground
- D. The gate connected to source

29. For a properly biased PNP transistor, let  $I_C=10\text{mA}$  and  $I_E=10.2\text{mA}$ . what is the level of  $I_B$ ?

- A. 0.2A
- B. 200mA

- C.  $200\mu\text{A}$
- D.  $20.2\text{mA}$

**30. When operated in cutoff and saturation, the transistor acts like**

- A. A linear amplifier
- B. A switch
- C. A variable capacitor
- D. A variable resistor

**SECTION B**

**[70 Marks]**

**PART I - DIGITAL ELECTRONICS**

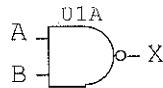
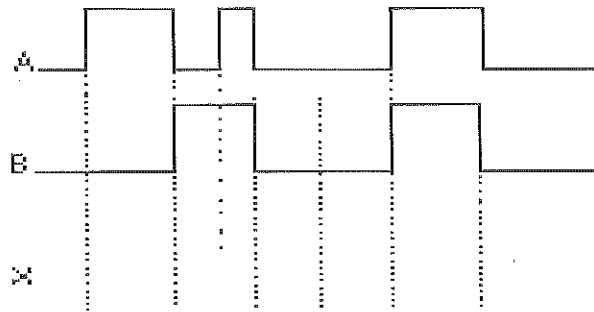
**QUESTION 1 (10 Marks)**

- a) With aid of diagrams explain the difference between **Analogue quantities** and **Digital quantities.** **(2 marks)**
- b) Determine the decimal value of the binary number  $101110_2$ . **(1 mark)**
- c) Convert  $170_{10}$  to BCD **(1 mark)**
- d) What is the binary representation for  $45_{10}$   
(Show working using division by 2 – method and multiplication by 2) **(2 marks)**
- e) Convert hexadecimal number FC3 to decimal number **(2 marks)**
- f) Convert the decimal number  $430_{10}$  to Excess – 3 codes. **(2 marks)**



**QUESTION 2 (15 MARKS)**

- a) If the two inputs **A** and **B** in **fig 3-b** are applied to that function, what is the resulting output waveforms **X**. \* (see appendix column for solution sheet).



**fig 3-b**

**(3 marks)**

- b) Using Boolean algebra techniques to simplify this expression:

$$AB + A(B + C) + B(B + C)$$

**(5 marks)**

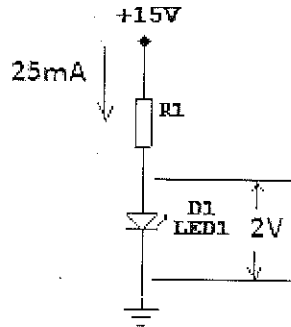
- c) For the function given below,

$$F(A,B,C,D) = \Sigma m(0,2,4,7,11,13,15)$$

- i. Show the truth table. **(2 marks)**
- ii. Show an algebraic expression in sum of minterm. **(2 marks)**
- iii. Show a minimum sum of product expression using Karnaugh Map. **(3 marks)**

**QUESTION 3 (15 MARKS)**

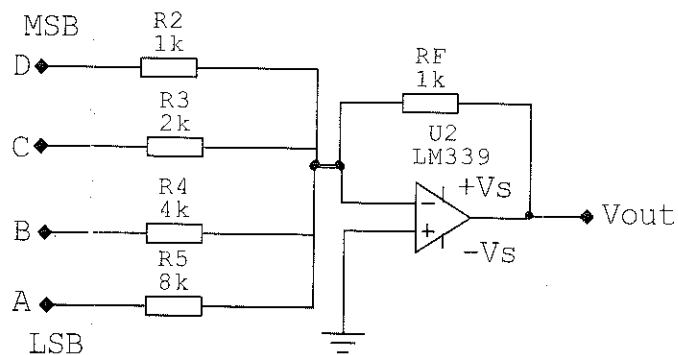
- a) Figure – 3a below shows an indicator circuit. Calculate the resistance value  $R_1$  needed for the circuit.



**Fig – 3a**

(2 marks)

- b) Figure – 3b below shows a four - bit Digital to Analog converter (DAC).



**Fig – 3b**

Calculate the output voltage ( $V_{out}$ ) if the DCBA inputs are as follows respectively:

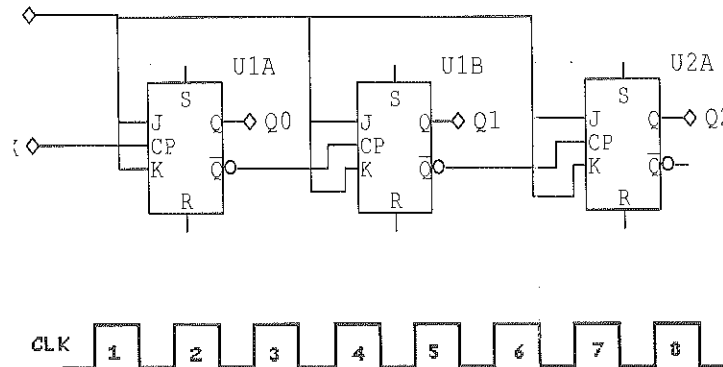
- i. 1011
- ii. 1100

(3 marks)

- c) Show how NAND gates only are used to perform the function of a **two - input OR gate**.

(3 marks)

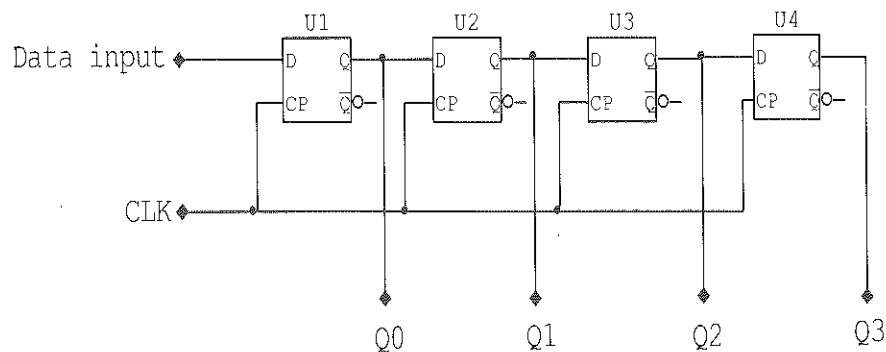
- d) For the **3 - bit Asynchronous Binary counter** shown in **Fig 3-d** below, determine its **Q** outputs (**Q<sub>0</sub> – Q<sub>3</sub>**) of each **flip-flop**. The flip-flops are connected for the Toggle operation (**J=1, K=1**) and are assumed to be initially RESET (**Q low**)  
**\*(See appendix column for solution sheet)**



**Fig 3-d**

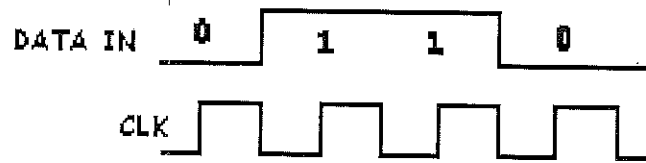
**(3 marks)**

- e) **Fig 3-e** below shows a **4 – Bit serial in / parallel out** shift register. The Data input contains 0110 after four clock pulses.



**Fig 3-e**

Show the states of the 4 – bit register (**Q<sub>0</sub>, Q<sub>1</sub>, Q<sub>2</sub>, and Q<sub>3</sub>**). The data input and clock waveforms are shown below. The register initially contains all 1s. **\*(See appendix column for solution sheet)**



(4 marks)

## PART II - ANALOGUE ELECTRONICS

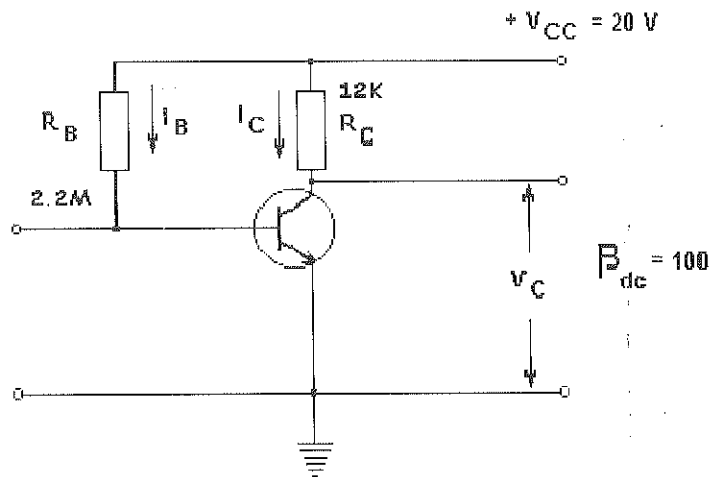
### QUESTION 1 (15 Marks)

- a) Draw the standard symbol of both the NPN and PNP transistor. (2 marks)
- b) Use the **BJT Data Sheet** provided to answer the questions asked.

| TYPE     | CASE        | POL MAT. | $V_{CE}$ | $V_{CB}$ | $I_{C\text{ mA}}$ | $V_{CES} @ I_{C\text{ mA}}$ | $H_{fe} @ I_{C\text{ mA}}$ | P(TOT) mW | USE          | EQUIVALENT          |
|----------|-------------|----------|----------|----------|-------------------|-----------------------------|----------------------------|-----------|--------------|---------------------|
| BD140    | TO-126      | PS       | 80       | 100      | 1.5A              | 0.5@500                     | 40@250                     | 8W        | G.P. o/p     | 40410               |
| BC107    | TO-18       | NS       | 45       | 50       | 100               | 0.25@10                     | 110@450                    | 300       | G.P.S.S. amp | BC207, BC147, BC182 |
| BC559    | TO-92 VAR 1 | PS       | 30       | 30       | 100               | 0.65@100                    | 125@800                    | 500       | G.P.S.S. amp | BC159               |
| 2N3055   | TO-3        | NS       | 60       | 70       | 15 A              | 1.1@4A                      | 20@70 4A                   | 115W      | G.P. power   | BDY 20              |
| TIP 3055 | TOP-3       | NS       | 70       | 100      | 15 A              | 1.1@4A                      | 20@ 4A                     | 90W       | Power output | MJE 3055            |

- Current gain of BC159 and what current can this transistor operate from? (2 marks)
- Material used in all transistors? (1 mark)
- Abbreviation of G.P.S.S. from the table. (2 marks)
- Power dissipation of BC147? (1 mark)
- Package of BDY20? (1 mark)
- Polarity of the BC182 transistor? (1 mark)

c) Refer to the circuit in **Fig 1-c** below

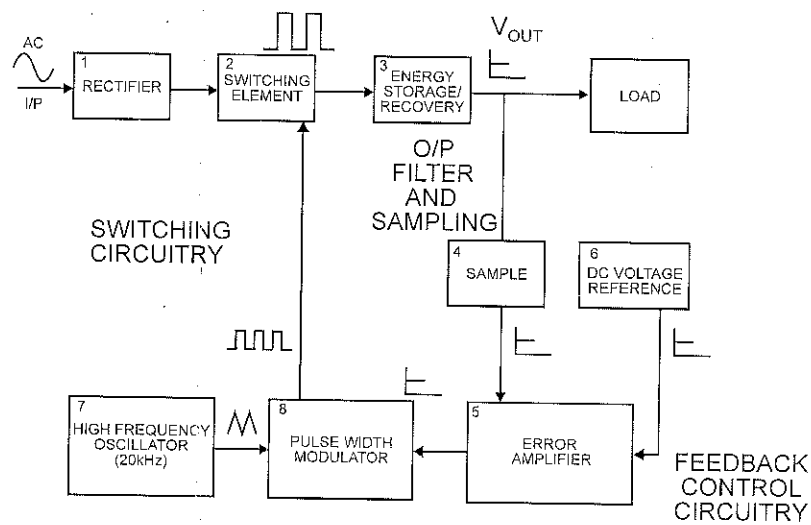


**Fig 1-c**

- Calculate the values of:
- i)  $I_B$  (2 marks)
  - ii)  $I_C$  (1 mark)
  - iii)  $V_C$  (2 marks)

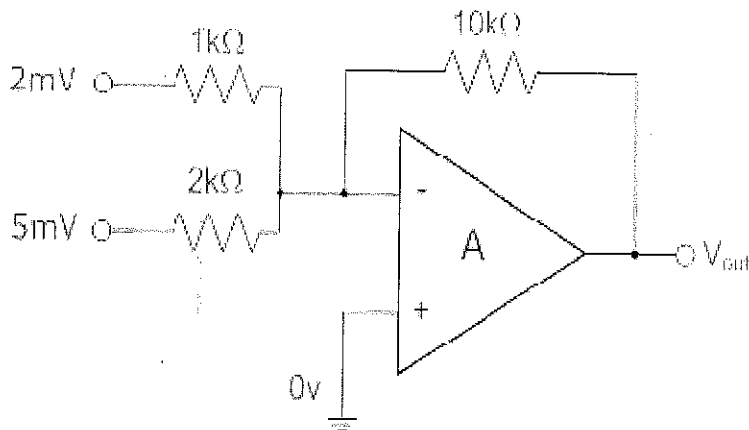
**QUESTION 2 [15 Marks]**

- a) A certain JFET has an  $I_{GSS}$  of 2nA for  $V_{GS} = -20V$ .  
Determine the input resistance? (3 marks)
- b) For the block diagram of the switched mode power supply given below, explain the functions of the following blocks:
- i) Switching Element (2 marks)
  - ii) Error amplifier (2 marks)
  - iii) High frequency Oscillator (2 marks)
  - iv) Pulse width modulator (2 marks)



c) Fig 2-c below shows a circuit diagram of an Op-Amp circuit.

- i) Identify the circuit. (1 mark)
- ii) Calculate the **output Voltage ( $V_o$ )**. (3 mark)



**THE END**

Candidate No: .....

**Section A**

**Multiple-Choice Matrix**

**[20 marks]**

Circle the correct letter (A, B, C or D) against each of numbers 1 through 30.

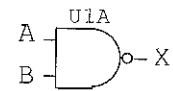
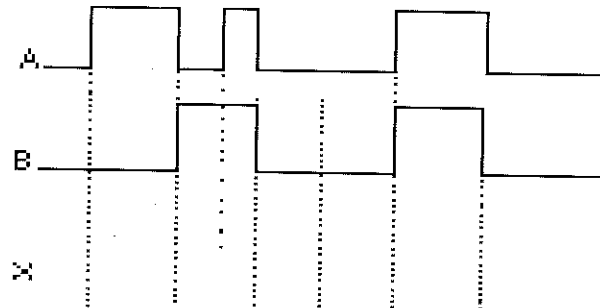
Remove and attach to your Answer Booklet.

|    |   |   |   |   |
|----|---|---|---|---|
| 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 |
| 21 | A | B | C | D |
| 22 | A | B | C | D |
| 23 | A | B | C | D |
| 24 | A | B | C | D |
| 25 | A | B | C | D |
| 26 | A | B | C | D |
| 27 | A | B | C | D |
| 28 | A | B | C | D |
| 29 | A | B | C | D |
| 30 | A | B | C | D |

**SECTION B**

**PART I – QUESTION 2**

2 – a



(3 marks)

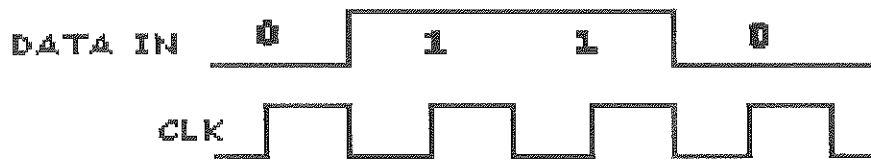
3 - d



(4 marks)



3 - e



(4 marks)

