ADVANCED LEVEL NATIONAL EXAMINATIONS, 2014
TECHNICAL AND PROFESSIONAL TRADES

EXAM TITLE: Analog and Digital Systems

OPTIONS: - Computer Electronics (CEL)
          - Electronics and Telecommunication (ETL)

DURATION: 3 hours

INSTRUCTIONS:

The paper consists of three (3) Sections:

Section I: Fourteen (14) questions, all Compulsory. 55 marks

Section II: Five (5) questions, Choose any Three (3). 30 marks

Section III: Three (3) questions, Choose any One (1). 15 marks
SECTION I. FOURTEEN (14) COMPULSORY QUESTIONS.

01. Find the canonical form of the following Boolean expression:

\[ F(A,B,C) = AB + BC. \]  

3marks

02. Design a D flip-flop from a J-K flip-flop.

2marks

03. What should be done to unused inputs on TTL gates?

5marks

04. Which functions a GTO gate drive circuit has to fulfill?

4marks

05. Identify two (2) different methods to represent basic logic functions.

2marks

06. Explain the functioning of the following circuit by turning ON and switch off quickly that circuit:

\[ Z = AB + A(B + C) + B(B + C). \]  

a) Without diode;  b) With diode mounted.

4marks

07. Identify the component of a typical transducer measurement system bloc (output digital).

5marks

08. Identify the components of the 555 timer.

5marks

09. Identify any five (5) methods of thyristor turn on.

5marks

10. Specify two (2) different methods of voltage control inverters.

2marks

11. Describe the function of freewheeling diode in a controlled rectifier circuit.

3marks

12. Identify any five (5) characteristics of an amplifier that are modified by negative feedback.

5marks

13. Simplify the following expression using Boolean algebra technique

\[ Z = AB + A(B + C) + B(B + C). \]

5marks

14. Identify five (5) applications of AC voltage controllers.

5marks
SECTION II. ATTEMPT ANY THREE (3) QUESTIONS.

15. a) Find the period (in msec) of the output pulse in the circuit shown below and give a name at this circuit.  

![555 Timer Circuit Diagram]

b) Show how a full adder may be implemented by using two half adders.  

16. Describe the basic operation of a single-slope analog to digital converter.  

17. Identify the logic families according to the technology they are built with and specify which family is widely used.  

18. In the following circuit, the specifications of zener diode at 25°C are: (1°) bias current: 10mA; (2°) output voltage: 2495mV  
The diode is forward biased at 2mA with forward voltage drop of 0.55V;  

![Zener Diode Circuit Diagram]

Determine $R_{b1}$ and $R_{b2}$ and select both values of resistors from the list of 1% decade values.  

19. a) For the circuit below, determine the function performed; the role of S1, Rb, Cb and S2.  

b) Determine different modes of operation of that circuit.  

![Gated Trigger Circuit Diagram]
SECTION III. ATTEMPT ANY ONE (1) QUESTION.

20. Consider the circuit below and answer to the following questions:
   a) Determine the type of circuit and its characteristics
   b) What is the function of VD1, VD2, VD3 and VD4
   c) Explain briefly the operation of the circuit.

   ![Circuit Diagram]

   15 marks

21. For the following circuit,
   a) Identify the main functional parts.
   b) Study the behavior.

   ![Circuit Diagram]

   15 marks

22. Consider the statement: “Z is TRUE if at least two of W, X and Y are TRUE”, otherwise Z is FALSE”.
   a) Write a Boolean expression for the above statement.
   b) Write a truth table for the function Z;
   c) Implements Z using only NOR gates.

   15 marks