NEW ZEALAND INSTITUTES OF TECHNOLOGY AND POLYTECHNIC QUALIFICATIONS IN INFORMATION & COMMUNICATIONS TECHNOLOGY

PRESCRIPTION: DE600 DIGITAL ELECTRONICS

AIM OF MODULE:	To provide students with the knowledge and skills needed to construct basic electronic digital circuits and to demonstrate the successful operation of these circuits, inherent in a wide range of electronic equipment.
KNOWLEDGE ASSUMED FROM:	DT500 Data Organisation (Compulsory)
STUDENT LEARNING HOURS:	70
CONTENT REVISED:	2010
PRESCRIPTION EXPIRY DATE:	November 2013

Level and Assessment Schedule

TOPICS	Highest Skill Level R	C	A	P	Suggested Assessment Percentage
1. Base (Mathematics) Systems			*		5
2. Boolean Algebra			*		15
3. Karnaugh Maps			*		15
4. Basic Logic Gates			*		10
5. Combinational Logic Functions			*		25
6. Synchronous & Asynchronous Logic Devices			*		30
					100

LEARNING OUTCOMES

The student will:

A 1 Explain the relationship between base numbering systems and the operation of electronic digital equipment and demonstrate appropriate (manual) mathematical techniques to perform a range of calculations

A 2 Explain the principles of boolean algebra in terms of the values that variables may assume, the operations applicable to those values and in the properties of those operations; i.e. the laws they obey, and use simple switch circuits to demonstrate boolean operations

A 3 Explain the use of the Karnaugh map, or Veitch diagram tool to facilitate the simplification of Boolean algebra IC expressions and simplify Boolean algebra IC expressions using this tool

A 4 Describe basic logic gates and demonstrate the configuration and operation of various combinations of these basic logic gates

A 5 Describe the application of basic logic gates to create combinational logic functions and demonstrate how these combinational logic functions perform binary arithmetic operations

A 6 Explain the principles of operation of synchronous and asynchronous logic devices, describe their applications and demonstrate and examine the operation of some examples of these devices using commercially available ICs

CONTENT

1 Base (Mathematics) Systems

- Explaining the relationship between base numbering systems and the operation of electronic digital equipment and demonstrating appropriate (manual) mathematical techniques to perform a range of calculations will include:
  - The binary numeral system (Base 2)
  - Octal (Base 8)
  - Hexadecimal (Base 16)
  - Addition and subtraction (including complementary arithmetic)
  - Conversion between the base numeral systems

2 Boolean Algebra

- Explaining the principles of Boolean algebra in terms of the values that variables may assume, the operations applicable to those values and in the properties of those operations; i.e. the laws they obey, and using simple switch circuits to demonstrate boolean operations will include:
  - Three basic Boolean operations OR, AND, and NOT
  - Tabulating their vaues using truth tables

- Using simple switch circuits to demonstrate the laws of Boolean algebra;
  - Commutative
  - Associative
  - Distributive
  - Identity
  - Redundance
  - De Morgan's theorem
- Using De Morgan's Theorem to convert Boolean expressions

3 Karnaugh Maps

➢ Explaining the use of the Karnaugh map, or Veitch diagram tool to facilitate the simplification of Boolean algebra IC expressions and simplifying Boolean algebra IC expressions using this tool will include:

- Drawing Karnaugh maps
- Simplifying Boolean expressions
- Verifying solutions

4 Basic Logic Gates

➢ Describing basic logic gates and demonstrating the configuration and operation of various combinations of these basic logic gates will include:

- AND, OR, NOT, NAND, NOR and XOR gates
  - Logic circuit symbols and truth tables
  - A description using simple diagrams
  - Demonstrating the configuration of a NAND gate and a NOR gate as an inverter

5 Combinational Logic Functions

➢ Describing the application of basic logic gates to create combinational logic functions and demonstrating how these combinational logic functions perform binary arithmetic operations will include:

- Various types of adders such as the;
  - Half adder
  - Full adder
  - XOR
  - Multiple-bit
  - Carry look-ahead
- Comparator
- Decimal to BCD and BCD to decimal encoders

6 Synchronous & Asynchronous Logic Devices

- Explaining the principles of operation of synchronous and asynchronous logic devices, describing their applications and demonstrating and examining the operation of examples of these devices using commercially available ICs will include:
  - The following devices;
    - Simple RS bistable using NAND or NOR gates
    - Gated RS bistable using NAND or NOR gates
    - D type bistable
    - JK bistable
    - Master-Slave bistable
    - Identifying the circuit symbols and deriving truth tables for each device
  - Counters;
    - JK bistable divide-by-two device
    - Divide-by-sixteen counter
    - Modifying the count/count sequence of the divide-by-sixteen counter
    - Comparison of synchronous and asynchronous devices, in terms of;
      - Truth tables
      - Speed of operation
      - Ripple through delay
      - Advantages and disadvantages
  - Registers;
    - 4-bit registers, in terms of;
      - Serial input
      - Parallel inputs
      - Clock input
      - Serial and parallel outputs
      - Modes of operation;
        - Shift control
        - Left and right shift
        - Parallel load
    - Data sheets for TTL and CMOS to compare performance in terms of speed and flexibility of operation

LEARNING RESOURCES

Digital Fundamentals (10th Edition) by Thomas L. Floyd. ISBN-13: 978-0132359238 (Published by Prentice Hall March 29, 2008)

Web Links:

Base (Mathematics) Systems http://en.wikipedia.org/wiki/Hexadecimal (Accessed August 2010)

Boolean Algebra http://en.wikipedia.org/wiki/Boolean_algebra_(introduction) & http://www.ee.surrey.ac.uk/Projects/Labview/boolalgebra/#table2 (Accessed August 2010)

De Morgan's Theorem http://en.wikipedia.org/wiki/De_Morgan's_laws (Accessed August 2010)

Karnaugh Maps http://en.wikipedia.org/wiki/Karnaugh_map (Accessed August 2010)

Combinational Logic Functions http://en.wikipedia.org/wiki/Adder_(electronics), http://scitec.uwichill.edu.bb/cmp/online/P10F/encoders.htm & http://www.educypedia.be/electronics/digitacounters.htm (Accessed August 2010)

Synchronous & Asynchronous Logic Devices http://www.electronics-tutorials.ws/sequential/seq_2.html (Accessed August 2010)

Counters http://www.cs.ualberta.ca/~amaral/courses/329/webslides/TopicJ-Counters/TopicJ-Counters.html (Accessed August 2010)

Data Sheets http://focus.ti.com/docs/prod/folders/print/cd74hct75.html & http://www.datasheetcatalog.org/datasheets/208/334730_DS.pdf (Accessed August 2010)