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

PRESCRIPTION: BS500 SEMICONDUCTOR THEORY

AIM OF MODULE:	Students will gain an understanding of the structure of semiconductor materials and the construction, characteristics and operational principles of semiconductor devices.
CREDITS:	14
STUDENT LEARNING HOURS:	140
CONTENT REVISED:	2008
PRESCRIPTION EXPIRY DATE:	Nov 2011

Level and Assessment Schedule

TOPICS	Highest Skill Level R	C	A	P	Suggested Assessment Percentage
1. Semiconductor Materials		*			10
2. Diodes		*			15
3. Bipolar Transistors		*			25
4. Unipolar Transistors		*			25
5. Thyristor family of semiconductors		*			25
					100

LEARNING OUTCOMES

The student will:

C 1 Describe the atomic structure of semiconductor materials, differentiate between conductors, insulators and semiconductors and explain the principles associated with the production of semiconductor materials

C 2 Explain the construction, characteristics and principles of operation of diodes

C 3 Explain the construction, characteristics and principles of operation of bipolar transistors

C 4 Explain the construction, characteristics and principles of operation of unipolar transistors

C 5 Explain the construction, characteristics and principles of operation of thyristor family of semiconductors including SCRs, diacs, sidacs and triacs

Content

1 Semiconductor Materials

- Describing the atomic structure of semiconductor materials, differentiating between conductors, insulators and semiconductors and explaining the principles associated with the production of semiconductor materials includes:
  - Resistivity of conductors, insulators and semi-conductors
  - Variations in conductivity due to changes in temperature
  - Silicon and germanium semi-conductor materials
  - Doping of semi-conductor materials
  - P and N type materials

2 Diodes

- Explaining the construction, characteristics and principles of operation of diodes includes:
  - Circuit symbol and polarity
  - Conventional and electron current flow
  - Properties related to construction materials (silicon and germanium)
    - Forward voltage drop
    - Leakage current
    - Junction capacitance
    - Peak inverse voltage (PIV)
    - Characteristic curves

3 Bipolar Junction Transistors

- Explaining the construction, characteristics and principles of operation of bipolar junction transistors includes:
  - Schematic symbols of NPN and PNP
  - Forward biased base-emitter junction and reversed biased base-collector junction
  - Electron flow and characteristic family of curves for NPN and PNP
  - Effects of leakage current
  - Common base, common emitter, and common collector (emitter follower) configurations

4 Unipolar Transistors

- Explaining the construction, characteristics and principles of operation of unipolar transistors includes:
  - Schematic symbols of JFETs and MOSFETs
  - JFET and MOSFET construction
    - Cross section of a CMOS integrated circuit
    - Physical structure of the enhancement type of NMOS transistor
  - JFET and MOSFET enhancement and depletion modes
  - Characteristics of junction field-effect transisitors

5 Thyristor Family of Semiconductors

- Explaining the construction, characteristics and principles of operation of thyristors, including silicon controlled rectifiers (SCRs), diacs, sidacs, and triacs, will involve:
  - Thyrister terms, symbols and definitions
  - Schematic symbols of SCRs, diacs, sidacs, and triacs
  - Block construction of SCRs
  - Basic operation and geometric construction (cross-sectional view) of;
    - An SCR
    - A diac
    - A sidac
    - A triac
  - Thyristor electrical characteristic curves
  - Thyristor switching methods

Note:

- The characteristics of the devices should be demonstrated by laboratory experiments.

Reading/Reference List:

- Electronic Fundamentals: Circuits, Devices, and Applications (7th Edition). Thomas L. Floyd ISBN-13: 978-0132197090 (Published by Prentice Hall, April 9, 2006)
- Web links:
  - **Semiconductor Materials** http://www.science-campus.com/engineering/electronics/semiconductor_theory/ (Accessed August 2008)
  - **Diodes** http://www.allaboutcircuits.com/vol_3/chpt_2/6.html &

    http://www.electronics-radio.com/articles/electronic_components/diode/pn-junction-diode.php (Accessed August 2008)
  - **Bipolar Junction Transistors** http://en.wikipedia.org/wiki/Bipolar_junction_transistor (Accessed August 2008)
  - **Unipolar Transistors** http://www.ece.uvic.ca/~btill/uvatt/discrete/review.pdf (Accessed August 2008)
  - **Thyristor Family of Semiconductors** http://www.educypedia.be/electronics/composetriac.htm &

    http://www.littelfuse.com/data/en/Application_Notes/AN1001.pdf (Accessed August 2008)