**CMP1202 Electronics II**

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| --- | --- | --- | --- | --- | --- | --- | --- |
| Period per  Week | | | Contact Hour per Semester | Weighted  Total Mark | Weighted  Exam Mark | Weighted Continuous Assessment Mark | Credit  Units |
| LH | PH | TH | CH | WTM | WEM | WCM | CU |
| 45 | 30 | 00 | 60 | 100 | 60 | 40 | 4 |

**Rationale**

This is a continuation of CMP1101: Electronics I.

**Objectives**

The course aims to provide the student with:

 An understanding of how complex devices such as field-effect transistors are modelled and how the models are used in the design and analysis of useful circuits.

 The capability to design and construct circuits, take measurements of circuit behavior and performance, compare with predicted circuit models and explain discrepancies.

**Course Content**

***1. Bipolar Transistors and Logic families***

 npn and pnp transistor operation

 i-v characteristics

 Regions of operation, models, and limitation

 Transfer characteristic of BJT with load resistor

 Biasing for logic and amplifier applications

 Logic level definitions

 The differential pair as a current switch

 Transistor-transistor logic – inverters, NAND, other functions

 Emitter-coupled logic – OR/NOR gate, other functions

 Low voltage bipolar logic families

***2. Design Parameters and Issues***

 Switching energy, power-delay product comparison

 Propagation delay, rise time, fall time

 Fan-in and fan-out

 Power dissipation, noise margin

 Power supply distribution

 Sources of signal coupling and degradation

 Transmission line effects

 passive, active, dc and ac termination

 Element tolerances

 Worst-case analysis of circuits

 Monte Carlo analysis

 Monte Carlo analysis in SPICE

 Six-sigma design

***3. Storage Elements***

 Latches

 Flip-flops

 Static RAM cells

 Dynamic RAM cells

 Sense amplifiers

***4. Interfacing Logic Families and Standard Buses***

 Terminal characteristics of various logic families

 Standard interface characteristics

 Level translations: TTL/CMOS, TTL/ECL, CMOS/ECL

 Single-ended to differential and differential to single-ended conversion

 Transmission line characteristics, reflections

 Bus termination: Passive, active, dc, ac

 4-20 mA current interfaces

 RS-XXX buses; IEEE-XXXX buses

 Low-level differential signaling

 RAMBUS

 DDR

***5. Circuit Modeling and Simulation***

 DC analysis

 AC analysis

 Transient analysis

 Simulation control options

 Built-in solid-state device models

 Device parameter control

 Libraries

 Mixed-mode simulation

**Learning Outcomes**

 Indicate the areas of use of bipolar logic families; and demonstrate the ability to implement a range of logic functions using bipolar logic.

 Incorporate design strategies in power distributions and transmission; and apply methods to minimize noise and other signal degradations.

 Compare and contrast the properties of different kinds of storage element to serve different purposes; and select (with reasons) appropriate kinds of storage elements for use in a range of possible devices.

 Explain the practical difficulties resulting from the distribution of signals; and explain ways to overcome these difficulties when interfacing different logic families.

 Explain with justification the ideal properties of operational amplifiers; design various amplifier structures and filters with ideal op-amps; understand characteristics of non-ideal op-amps; and design simple circuits with them.

 Explain with justification the benefits and the drawbacks associated with the simulation of circuits; identify aspects of circuits that are not readily amenable to simulation; and simulate a range of possible circuits using a suitable software package.

**Recommended and Reference Books**

*[1]* Agarwal, Anant, and Jeffrey H. Lang.  **Foundations of Analog and Digital Electronic Circuits**. San Mateo, CA: Morgan Kaufmann Publishers, Elsevier, July 2005. ISBN: 9781558607354.

*[2]* Earl D. Gates, *Introduction to Electronics*, 4th ed., Thomson, 2004

*[3]* D. C. Green, *Electronics 4,* 3rd ed., Longman, 1995