

PGT104 - Digital Electronics

This course is *Digital Electronics*, offered by the Department of Electronics Engineering Technology.

The textbook for this course is [Floyd's Digital Fundamentals](#) (11th Edition at the moment).

Try [my1digitaljs](#) - a Basic Digital Electronics Simulator (notice, NOT logic simulator :p) that I have developed for PGT104. Based on [SimCirJS](#), the source is available [here](#). Some video guides are available [on Youtube](#)

Please note that this is a continuously updated site. Check the timestamps/dates (if any) to make sure that the information is applicable to current course implementation. Some information are from the previous ones.

Announcements

[20190130] Welcome to PGT104 Academic Session 2018/19 S2!

[20190226] Tentative date for Mid-Term is 21/03/2019 (THU)!

[20190307] Mid-Term Exam set on 19/03/2019 (TUE) @9.00pm

Lecture Slides

Applicable for Academic Session 2018/2019 Semester 2

- Lecture Part 0 - [Course Introduction](#)
- Lecture Part 1 - [Introduction to Number Systems](#)
- Lecture Part 2 - [Logic Gates](#)
- Lecture Part 3 - [Boolean Algebra](#)
- Lecture Part 4 - [Combinational Logic Circuits](#)
- Lecture Part 5 - [Latches, Flip-flop and Timers](#)
- Lecture Part 6 - [Sequential Logic Circuits](#)

Note: Textbook coverage is as follows...

Topic	Chapter	Sections
1	2	(2.1)-(2.10)
2	3	(3.1)-(3.6)
3	4	(4.1)-(4.8)
4	6	(6.1)-(6.9)
5	7	(7.1)-(7.6)
6	8-9	(8.1)-(8.4), (9.2)-(9.3)

Lab Notes

- Lab Work 1 - [Basic Equipment/Components \(Part 1,Part 2\)](#)
- Lab Work 2 - [Combinational Logic Circuits \(Part 1,Part 2,Part 3\)](#)
- Lab Work 3 - [Sequential Logic Circuits \(Part 1, Part 2, Part 3\)](#)
- Lab Work 4 - (Free sessions) Shift registers and counters (theory to practical)

Assignments

- [Assignment 1](#)
 - Please attach this page (with your name and student ID) in front of your answer sheets.
 - **Due: 14/03/2019 (THU-W6-Lecture Session).**
- [Assignment 2](#)
 - Please attach this page (with your name and student ID) in front of your answer sheets.
 - **Due: 09/05/2019 (THU-W13-MY_ROOM@[S4-L1-70]-12PM).**

Course Synopsis

Note: Written by the course coordinator when first offered

Introduction and discussion of fundamental of digital circuit design and analysis. The lecture and tutorial exercise covers the following topics: Boolean Algebra, Numbering System, Basic Logic Gates, Combinational Circuit Design, Timing Diagram, Bi-Stable Memory Device and Sequential Circuit Design.

Course Outcome

Note: These have been slightly re-written from the original/previous session

- CO1: Ability to describe numbering systems and boolean algebra
- CO2: Ability to analyze Boolean expressions and logic circuits for a simple digital system
- CO3: Ability to design combinational or sequential logic circuits for a simple digital system

Course Assessment

	Examinations		Course Work	
Total Contribution	60%		40%	
Assessment	Mid-Term	Final Exam	Assignments	Lab Assessments
Contribution	10%	50%	10%	30%

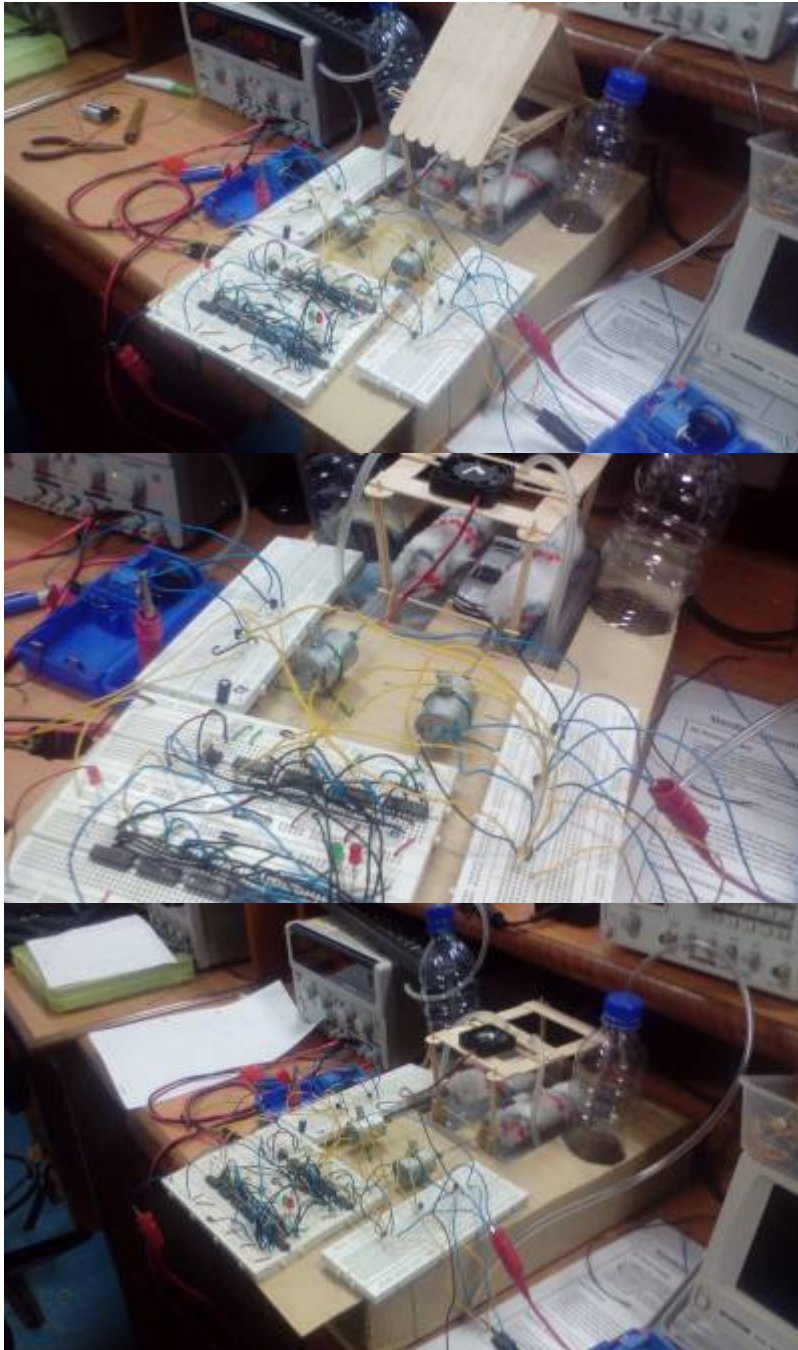
Course Syllabus

Week	Lecture	Laboratory	Notes
Week 01	- Course Introduction (Lecture 00) - introduction to digital electronics - Introduction to Numbering Systems (Lecture 01) - decimal numbers, binary numbers - conversions, binary arithmetic - value and representation - hexadecimal and octal numbers - binary-coded decimal	Lab Work 1	Textbook: Chapter 2
Week 02	- Logic Gates (Lecture 02) - Boolean Logic, Inverter (N)AND, (N)OR, X(N)OR gates	Lab Work 1 (cont.)	Textbook: Chapter 3
Week 03	- Boolean Algebra (Lecture 03) - Boolean operations and expressions - DeMorgan's Theorems - logic simplification	Lab Work 2	Textbook: Chapter 4 Assignment 1 Queue
Week 04	- Boolean Algebra (cont.) (Lecture 03) - standard forms: SOP, POS - truth table and Karnaugh Map	Lab Work 2 (cont.)	Textbook: Chapter 4
Week 05	- Boolean Algebra (cont.) (Lecture 03) - practical problems & solutions	Lab Work 2 (cont.)	Textbook: Chapter 4 Assignment 1 Due (5%)
Week 06	- Combinational Logic Circuits (Lecture 04) - half & full adders - carry circuits - comparators	Lab Work 2 (cont.)	Textbook: Chapter 6 Lab Assessment 1 (10%)

Week	Lecture	Laboratory	Notes
Week 07	- Combinational Logic Circuits (cont.) (Lecture 04) ◦ decoders, encoders ◦ multiplexer, demultiplexer	Lab Work 2 (cont.)	Textbook: Chapter 6 Mid-term Examination (10%)
Week 08	- Combinational Logic Circuits (cont.) (Lecture 04) ◦ applications in digital systems	Lab Work 2 (cont.)	Textbook: Chapter 6
Week 09	- Latches, Flip-flops, and Timers (Lecture 05) ◦ latches & flip-flops	Lab Work 3	Textbook: Chapter 7 Assignment 2 Queue
Week 10	- Latches, Flip-flops, and Timers (cont.) (Lecture 05) ◦ one-shots and oscillators	Lab Work 3 (cont.)	Textbook: Chapter 7 Lab Assessment 2 (10%)
Week 11	- Latches, Flip-flops, and Timers (cont.) (Lecture 05) ◦ applications in digital systems	Lab Work 3 (cont.)	Textbook: Chapter 7 Assignment 2 Due (5%)
Week 12	- Sequential Logic Circuits (Lecture 06) ◦ shift registers (load, shift left, shift right)	Lab Work 3 (cont.)	Textbook: Chapter 8-9
Week 13	- Sequential Logic Circuits (cont.) (Lecture 06) ◦ counters (asynchronous, synchronous)	Lab Work 3 (cont.)	Textbook: Chapter 8-9
Week 14	- Sequential Logic Circuits (cont.) (Lecture 06) ◦ applications in digital systems	Lab Work 3 (cont.)	Textbook: Chapter 8-9 Lab Assessment 3 (10%)

Once Upon a Time in PGT104

20170526 *Project Demonstration: A Car-Wash System using a state-machine built with discrete logic gates*



Short video clip (sorry, no audio)

[pgt104_lab_project_ry44_grade_a.mp4](#)

Digital Electronic Lab Kit

[pgt104_labkit.txt](#)

Basic Gates / IC:

- 2 x 7400 - Quad 2-input NAND
- 1 x 7404 - Hex INVERTER
- 1 x 7408 - Quad 2-input AND
- 1 x 7402 - Quad 2-input NOR

- 1 x 7432 - Quad 2-input OR
- 1 x 7486 - Quad 2-input XOR
- 2 x 7474 - Dual D Flip-flop (async P/C)
- 1 x 7476 - Dual JK Flip-flop (async P/C)
- 1 x 555 - Timer

Basic Components:

- 4 x LED (Red/Green)
- 4 x Push/Reset Button
- 1 x 4-Way DIP Switch
- 12 x 1k Resistor
- 1 x 7-segment
- 8 x 220ohm Resistor
- 2 x 100k Resistor
- 2 x 10k Resistor
- 1 x 10uF Capacitor
- 1 x 1uF Capacitor
- 1 x 10nF Capacitor

Prototyping:

- Breadboard
- Jumper wires (M-M)
- @ 4 long wires for power
- @ 8 medium length for inter-IC
- @ 38 short length for direct wiring

Food for Thought

A more practical implementation of Digital Electronic Courses:

- Digital 1
 - base-n numbering systems
 - basic logic (truth table, boolean equation, boolean algebra, POS/SOP form)
 - combinational logic (basic gates)
 - combinational logic implementation (e.g. adder) ← just pick one example
 - sequential logic (basic flip-flop)
- Digital 2 :
 - combinational logic circuits (mux, decoder, encoder)
 - practical application: e.g. instruction decoder, address decoding, etc.
 - sequential logic circuits (registers, counters)
 - practical application: e.g. program counter
 - state machines

Note: If Digital 1 is seen as too light, the combinational logic circuits topic from 2 can be shifted into 1... then, some basic Computer Architecture stuffs can be put into 2.

Maybe something like this...

Digital Electronics 1			
Week	Lecture	Laboratory	Notes
Week 01 - 03	• Introduction to Digital Electronics • Numbering Systems ◦ decimal numbers, binary numbers ◦ conversions ◦ basic binary arithmetic ◦ hexadecimal and octal numbers ◦ binary-coded decimal • Logic Gates ◦ Boolean Logic, Inverter ◦ (N)AND, (N)OR, X(N)OR gates • Numbering Systems (cont.) ◦ unsigned and signed binary ◦ signed binary arithmetic		<i>Comment1: Need to cover topic on Logic Gates as soon as possible in order to start with lab sessions.</i> <i>Comment2: Previous experience show students need more time on topics involving signed binaries.</i>
Week 04 - 07	• Boolean Algebra ◦ Boolean operations and expressions ◦ DeMorgan's Theorems ◦ Logic simplification/reduction ◦ standard forms: SOP, POS ◦ truth table and Karnaugh Map		
Week 08 - 11	• Combinational Logic Circuits ◦ 1-bit half & full adder ◦ 4-bit adders (ripple carry) ◦ carry circuit (carry look ahead)		

Digital Electronics 1			
Week	Lecture	Laboratory	Notes
Week 12 - 14	- Latches, Flip-flops, and Timers - latches - timing diagrams - flip-flops (JK-FF, D-FF, T-FF) - basic 555 timer		
Digital Electronics 2			
Week	Lecture	Laboratory	Notes
Week 01 - 02	- Refresh Basic Digital Electronics - combinational & sequential - boolean algebra, timing diagrams - Combinational Logic Circuits - adder, subtractor, binary comparator		
Week 03 - 05	- Combinational Logic Circuits - Decoders, encoders - Multiplexers, demultiplexers		
Week 06 - 07	- Refresh Sequential Logic Elements - latches/flip-flops - Shift Registers (left/right/load)		
Week 08 - 09	- Counters - Basic binary counter (up/down) - Gray Counter		
Week 10 - 12	- Finite State Machine - Mealy/Moore Machine - State diagrams - State encoding - Next-state logic		

Digital Electronics 1			
Week	Lecture	Laboratory	Notes
Week 13 - 14	• Simple Digital Systems (Case studies) ◦ digital control system (e.g. train crossing gate control)		

From:

<http://azman.unimap.edu.my/dokuwiki/> - Azman @UniMAP

Permanent link:

<http://azman.unimap.edu.my/dokuwiki/doku.php?id=archive:pgt104>

Last update: **2022/02/10 10:05**

