



National Taiwan University of Science and Technology

2021 Summer Program

ELEC 220 Digital Logic Circuits

Course Outline

Course Code: ELEC 220

Instructor: Jordan Morelli, Ph.D., P.Eng.

Home Institution: Queen's University

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Credit: 4

Course Description:

Electronic devices and digital circuits are explored. Topics include: binary arithmetic; Boolean algebra and switching functions; gates and flip-flops; combinational and sequential logic circuits; data converters; and computer-aided design tools for digital design, simulation, and testing.

Required Textbooks:

Neil Storey, "Electronics: A Systems Approach", 6th Ed., 2017 (note: the 5th or 4th editions are also fine).

Grading & Evaluation:

Homework Assignments: 30%

Laboratory Work: 20%

Midterm Exam: 20%

Final Exam: 30%

There will be one homework assignment due at the start of class every Tuesday and Thursday. Each assignment will take you about ninety minutes to complete. Your two lowest homework marks will be dropped in calculating your final grade.

Each lecture topic will have a corresponding problem-solving session.

Each student is required to purchase a laboratory kit. The components list is included below as Appendix A.

Course work throughout the session will be assessed using percentage grades, but the final course grade will be converted to a letter grade according to the following scale: A (94%-100%), A- (90%-93%), B+ (87%-89%), B (84%-86%), B- (80%-83%), C+ (77%-79%), C (74%-76%), C-



(70%-73%), D (60%-69%), and F (59% and below). Note: most colleges and universities do not award transfer credit for grades of D or F.

Attendance: Attendance at every class session is mandatory.

Course Schedule:

Week 1:

Topic 1: Introduction to digital systems

Topic 2: Number systems and binary arithmetic

Topic 3: Binary codes and coding systems

Lab 1: Basic electrical measurements using an Arduino Uno

Week 2:

Topic 4: Boolean algebra

Topic 5: Design and analysis of combinational logic circuits

Topic 6: Circuit minimisation techniques (Karnaugh maps and Boolean algebraic approaches)

Topic 7: Timing issues and common combinational logic circuits

Lab 2: Introduction to OrCAD

Week 3:

Topic 8: Sequential logic, latches and flip-flops

Midterm Examination

Topic 9: Counters and shift registers

Lab 3: Logic gates and the full adder

Week 4:

Topic 10: Data converters

Topic 11: Design and analysis of sequential logic circuits

Topic 12: Simulation and timing analysis of sequential circuits

Lab 4: Digital-to-analog conversion

Final Examination



Appendix A – Laboratory Kit Component List

All students require an electronics kit consisting of at least the following components:

Required:

- 1 x Arduino Uno R3 board
- 1 x USB cable type A/B
- 1 x solderless breadboard (min 400 tie points)
- 1 x 40 pin male-male jumper wires (20cm in length)
- 1 x 40 pin male-male jumper wires (10cm in length)
- 15 x 5mm LEDs (5 each: red, amber, green)
- 2 x 74LS00 (Quad NAND)
- 2 x 74HC00 (Quad NAND)
- 2 x 74LS86 (Quad XOR)
- 2 x 74LS02 (Quad NOR)
- 2 x 74LS04 (Hex inverter)
- 2 x 74LS08 (Quad AND)
- 2 x 74LS32 (Quad OR)
- 100 x resistors (10 each: 100 Ω , 220 Ω , 330 Ω , 1k Ω , 2k Ω , 5k Ω , 10k Ω , 20k Ω , 100k Ω , 1M Ω)
- 5 x SPST pushbutton switches
- 2 x LF411 OpAmps

Optional:

- 5 x 1N4007 diodes
- 6 x potentiometers (2 each: 10k Ω , 50k Ω , 100k Ω)
- 2 x thermistor NTC-103 (10k Ω)
- 2 x photoresistor (LDR) (CdS 161, 200k Ω dark resistance)
- 35 ceramic capacitors (5 each: 22pF, 0.01 μ F, 0.033 μ F, 0.047 μ F, 0.1 μ F, 0.33 μ F, 0.47 μ F)
- 8 capacitors (4 each: 10 μ F, 100 μ F) 50V
- 5 x BC547 npn transistors
- 5 x BC557 pnp transistors
- 2 x LM555
- 1 x Phototransistor (OP506A)