Course number and name
1. Course number and name
EE 324: Fundamentals of Digital Systems

2. Credits and contact hours
4 (3 lecture hours and 3 lab hours per week)

3. Instructor’s or course coordinator’s name
Clint Cole

4. Text book, title, author, and year

Other supplemental materials
Blackboard circuit board (Real Digital); Vivado Webpack (Xilinx); Instructor notes and slides for some topics

5. Specific course information
   a. Catalog description: Design and analysis digital systems emphasizing synchronous circuits for control, communication, and signal and data processing; tightly coupled hardware/software systems; use of modern CAD tools and technologies; basic system-level electronics.
   b. Prerequisites or co-requisites: EE214; EE234

6. Specific goals for the course
At the end of this course, students must be able to:
   • Correctly construct arbitrarily complex combinational and sequential digital circuit models using Verilog (1,2,6)
   • Simulate, synthesize, and validate digital systems using modern design technologies and CAD tools (1,2,6)
   • Know how to process input and output signals to and from different clock domains (1,2,6)
   • Be able to construct digital IP blocks that are addressable via the AXI bus (1,2,6)
   • Be able to implement sequential behaviors using hardware or software-based solutions (1,2,6)
   • Be able to create and evaluate different implementations to meet a stated behavioral requirement (1,2,6)
   • Be able to codesign circuits and interface them with designs from other engineers (3,5)
   • Present technical design details to a design review team (3,5)

7. Brief list of topics to be covered
   • Review of combinational and sequential circuits and design methods,
   • The Verilog language, syntax and modelling methods,
   • Verilog timing and simulator models,
   • Inputs and outputs to and from sequential circuits,
• Clock management and transitioning data between clock domains,
• System reset considerations,
• FPGA and programmable device architectures,
• AXI bus overview, signaling protocols, and timing/control,
• Multiple sequential circuits and their coordination,
• Logic system synthesizers overview,
• Hardware/software codesign, tradeoffs, and partitioning,
• CAD tool topics: output files, timing analyzer, floor planner, and IP integrator.
2. Credits and contact hours
   3 credits, 3 contact hours per week

3. Instructor’s or course coordinator’s name
   Sandip Roy

4. Textbook, title, author, and year
   Other supplemental materials
   Also, lecture notes are provided to the students.

5. Specific course information
   a. Brief description: EE 321 enhances the students’ introduction to linear circuit analysis toward a systematic solution and design methodology, based on differential-equation formalisms. This general circuit analysis serves as a starting point toward an introduction to core tools in systems and signals analysis for electrical engineers.
   b. Prerequisites or corequisites: Completion of Circuits I (EE 261) and Differential Equations with grade of C or better, or permission of instructor.

6. Specific Goals and Objectives:
   EE 321 provides a development of core systems and signals concepts, and their application to linear circuits analysis and design. By the end of the course, students should be able to
   a) write differential-equation models for linear circuits, and to put these circuit differential equations into standard, state-space-, and Laplace-domain forms;
   b) solve linear differential equations or circuits using several methods, including the method of undetermined coefficients, the convolution-based approach, Laplace-domain solutions, and state-space-based solutions (by computer);
   c) understand core system-theory concepts and constructs such as the transfer function, frequency response, and impulse response;
   d) design and analyze filter circuits;
   e) understand the operation of mutual inductors, as an additional circuit component;
   f) understand and be able to apply several mathematical techniques underlying systems/signal analysis, including Laplace-domain analysis, Fourier Series, and Fourier Transforms.

   By the end of the course, students should be able to:
   ● Apply circuits-engineering principles to analyze linear dynamic circuits (Outcomes 1a-1e)
   ● Design linear dynamic circuits that meet performance specifications such as filter and time-domain specification (Outcomes 2a-2g)
● Communicate motivations, methods, and outcomes for circuit design tasks such as filter design (Outcomes 3a-3e)
● Work in teams to analyze and design circuits (Outcome 5b)
● Apply knowledge and information to analyze/design circuits (Outcomes 6a, 6c)

7. Brief List of Course Topics
   • Developing differential-equation models for linear circuits
   • Solving differential equations using the method of undetermined coefficients
   • Using convolution to solve circuits/differential equations
   • Solving circuits and differential equations by computer using the state-space form
   • New circuit elements: mutual and ideal transformers
   • Laplace Transform mathematics
   • Solving circuits and differential equations using Laplace transforms
   • Core system-theoretic concepts: transfer function and impulse response
   • Frequency response (including drawing and interpreting Bode plots)
   • Design of filter and amplifier circuits
   • Fourier series: mathematics
   • Fourier series: application to circuits and systems analysis
   • Fourier transforms: introduction