Introduction
This coursework has two main parts: a DAC, and a power supply. You are required to design and simulate each individually, and then evaluate the overall system performance.

Specification
This coursework contributes 10% of the mark for ELEC2216, so should take you up to 15 hours to complete. You are advised to use Multisim to carry out simulations, though you may use a different package if you wish. You may need to import component SPICE models into this environment. You are required to go through the following steps:

Part 1: Design of a Binary-Weighted DAC
Design and simulate the operation of a 4-bit binary-weighted DAC. You should choose an appropriate op-amp and other component values. Use real devices, not the ‘ideal’ or ‘virtual’ components that can be used in SPICE.
Add a unity-gain inverting stage to the output so that the output from the DAC is positive, and add a 10kΩ ‘load’ between its output and ground.
You can assume that you have access to a dual DC supply (e.g. ±10V), and you have digital (e.g. TTL) lines to control transistors to switch this supply through to the DAC inputs, i.e. you should not drive the DAC inputs directly from the digital signals. You should aim to deliver a maximum output of around 5V from your DAC.
Evaluate the performance of your DAC by stepping through all values, and then its behaviour when there is a rapid change in input value. Evaluate its linearity, accuracy, and settling time. What is its current draw on each rail, and how is this affected by the digital input values?

Part 2: Design of an AC Power Supply
2.1 Implementation of Basic Supply
Design and simulate the performance of a power supply for your system. You need to power it from a 230 Vrms 50 Hz mains supply. It should be able to provide a dual ±10V supply to your DAC, at the current values determined in Part 1, but in this part you are simulating the power supply on its own.

Your supply should initially be based on a transformer (which may be ideal, and centre-tapped if appropriate), a bridge rectifier (which should be constructed from real, rather than ideal, diodes), and smoothing capacitors. Aim for less than 5% ripple. Add resistors to the outputs to act as loads ‘sinking’ the currents calculated in Part 1. Simulate your power supply’s performance (output voltage, efficiency, ripple).

2.2 Enhancement of the AC Power Supply
You need to add linear regulators to the supply to further remove ripple. Choose appropriate commercial devices and incorporate them into your circuit, by modifying the design from Part 2.1. What changes did you choose to make? With the same loads, what is the enhanced power supply’s performance?
2.3 Replacement of Linear Regulator
Replace one of the linear regulators with a transistor-based linear regulator. Initially characterise the performance of this regulator on its own, in terms of its load and line regulation and efficiency with the expected load current. Next, incorporate it into your circuit by modifying the design from Part 2.2. How does it affect the ripple voltage?

Part 3: Complete System Simulation
You should power your DAC from your power supply produced in Part 2.3. Simulate the performance of the complete system: does each part perform as well as initially simulated? Is ripple from the power supply observable on the DAC output, and if so how much?

Guidance
You may discuss this coursework with your classmates, but the simulations and report you hand in should be entirely your own.

You can treat the following items as extension tasks, which are only expected to be completed by the keenest students:

- Replace both linear regulators with transistor-based regulators, and observe performance.
- Replace the linear regulators with op-amp based linear regulators, and observe performance.
- Improve the power efficiency of the system.

You should write a report about your design, functionality and results. This should be a maximum of 5 pages (minimum 10pt, single-spaced, A4).

Hand-in and Marking
Hand-in is electronic-only via handin.ecs.soton.ac.uk, deadline is 16.00 on Friday 11 May 2017. You will need to submit a ZIP of your simulation/design files along with a PDF of your report. It will be marked out of 10, with credit given for design, simulation and evaluation of (1) the DAC [25%], (2) the power supply [60%], and (3) the complete system [15%].