EE204FZ
Lecture 10
Final Exam Review

Zhu DIAO

Email: zhu.diao@mu.ie

Final Exam: When & How?

- The final exam is scheduled at 2:30 – 4:30pm on 04/01/2021 (week 19). You are given two hours in total, and calculators are allowed. The format of the exam is very similar to that of last year's final exam. Last year's final exam paper is provided on Moodle.
- The final exam is 70% of your final grade. The other 30% of your final grade comes from lab reports. The assessment criteria have been discussed in the first lecture of this module. No change has been made.
- This is the last lecture of this module. If you have any questions between now and the final exam, please feel free to contact me through emails (zhu.diao@mu.ie) or on Microsoft Teams.

Lecture 2: p-n Junction Diodes

- What is a p-n junction?
- The depletion region;
- Majority and minority carriers;
- Forward bias and reverse bias;
- Principles of operation of a p-n junction diode;
- Diode equation.

- It makes up <5% of the questions in the final exam.

Lecture 3: Junction Field Effect Transistors

- Differences between FETs and BJTs;
- Three terminals of JFETs;
- Principles of operation of JFETs;
- I_D vs. V_{DS} plot (two operation regions);
- Shockley's transistor equation;
- Transfer curves (I_D vs. V_{GS} in the saturation region).

- It makes up <10% of the questions in the final exam.

Lecture 4: MOSFETs

- Structure of MOSFETs;
- Principles of operation of MOSFETs (threshold voltage, inversion region, pinch-off, and channel length modulation);
- I_D vs. V_{DS} plot for enhancement-type MOSFETs (three operation regions: cut-off, triode, active or saturation, and the conditions for each region);
- Parasitic capacitances (C_{GS} and C_{GD});
- NMOS, PMOS and CMOS;
- Enhancement- *vs*. depletion-type MOSFETs;
- MOSFET equation and applications (finding the quiescent point).

Lecture 5: Applications of MOSFETs

- Using a MOSFET as a resistor (summary on slide 9);
- Simple circuits in which MOSFETs are used as switches;
- CMOS inverter and logic gates (NAND and NOR). A summary can be found on slide 27;
- Understand the advantages of CMOS logic from the perspective of power consumption;
- Pull-down/pull-up switches;
- Transmission gate.

Lecture 6: Models & Biasing

- Understand the difference between small signals and large signals;
- Understand the importance of biasing for the operation of transistor circuits;
- Understand what piecewise linear is;
- The most important information is on slides 39 and 40.

- It makes up <5% of the questions in the final exam.

Lecture 7: FET amplifiers

- Small-signal hybrid-π model (draw the small-signal equivalent circuit and name the terminals);
- The forward transconductance (g_m) and the output resistance (r_{DS}). Understand their relations to large-signal parameters;
- The voltage gain of an ideal common source FET amplifier;
- Understand what clipping is and how to prevent it;
- Three common biasing schemes (fixed biasing, voltage-divider biasing, and drain-feedback biasing);
- The use of (de)-coupling capacitors;
- The influence of C_{GS} and C_{GD} on FET amplifier output;
- The Miller effect;
- Current mirror and current multiplier (slides 100 and 101);
- The source follower circuit.

Lecture 8: Operational Amplifiers

- Ideal op-amps *vs*. practical op-amps;
- Advantages of a high input impedance and a low output impedance;
- Slew rate;
- Open-loop gain *vs*. closed-loop gain;
- Common op-amp circuits with negative feedback (voltage follower, inverting amplifier, summing amplifier, differential amplifier, and non-inverting amplifier);
- Integrator and differentiator, first-order active filters (low-pass and high-pass), and Sallen-Key filters (low-pass and high-pass).

Lecture 9: Bipolar Junction Transistors

- The only thing that may be tested in the final exam is the difference between BJTs and FETs;
- Otherwise, will not show up in the final exam.