HUMBER

Course Outline

Course Name: Electronic Devices and Circuits (TECH 150)

Academic Period: 2022 - 2023

Faculty:

Faculty Availability:

Associate Dean:
Shaun Ghafari
shaun.ghafari@humber.ca

Schedule Type Code:

Land Acknowledgement

Humber College is located within the traditional and treaty lands of the Mississaugas of the Credit. Known as Adoobiigok [A-doe-bee-goke], the "Place of the Alders" in Michi Saagiig [Mi-Chee Saw-Geeg] language, the region is uniquely situated along Humber River Watershed, which historically provided an integral connection for Anishinaabe [Ah-nish-nah-bay], Haudenosaunee [Hoeden-no-shownee], and Wendat [Wine-Dot] peoples between the Ontario Lakeshore and the Lake Simcoe/Georgian Bay regions. Now home to people of numerous nations, Adoobiigok continues to provide a vital source of interconnection for all.

Equity, Diversity and Inclusion Statement

Humber College and the University of Guelph-Humber (Humber) are leaders in providing a learning, working and living environment that recognizes and values equity, diversity and inclusion in all its programs and services. Humber commits to reflect the diversity of the communities the College serves. Students, faculty, support and administrative staff feel a sense of belonging and have opportunities to be their authentic selves.

Faculty or Department	Faculty of Applied Sciences & Technology
Course Name:	Electronic Devices and Circuits (TECH 150)
Pre-Requisites	none
Co-Requisites	none
Equates	none
Restrictions	none
Credit Value	3
Total Course Hours	56

Developed By: **Prepared By:** **Approved by:**

Shaun Ghafari

Humber Learning Outcomes (HLOs) in this course.

The HLOs are a cross-institutional learning outcomes strategy aimed at equipping Humber graduates with the employability skills, mindsets, and values they need to succeed in the future of work. To explore all the HLOs, please consult the Humber Learning Outcomes framework.

Course Description

N/A

Course Rationale

The students entering this 2nd semester course have a background in basic electric circuits, mostly DC. Concurrently to this course they take AC Circuits. If in the Electronics program, they also take a practical amplifier construction and simulation course concurrently. This course in turn forms the basis for further study in analog circuitry, radio-frequency circuitry, sensor interfacing and instrumentation.

Course Learning Method(s)

- Group or Team Work
- Lecture
- Student-led Learning
- Inquiry Based Learning
- Online

Learning Outcomes

- Analyze the effects of temperature on semiconductors by studying N type and P type semiconductor materials.
- Test a commercial semiconductor diode using an ohmmeter, after identifying the anode and cathode leads.
- Examine the operation of a bridge rectifier circuit complete with the required transformer and filter capacitor, including theoretical analysis and circuit testing.
- Construct Zener diode voltage regulator circuits , including analysis and laboratory testing using standard test equipment and signal generators.
- Describe the construction details, operation, data sheet specifications, effects of temperature, and operating characteristics of a BJT to establish a given operating point for BJT Switch, BJT class A, class B, class AB and class C amplifier circuits, demonstrating the circuit power and efficiency.
- Design a basic BJT switch circuit to operate an LED, resistor load or relay coil.
- Describe the important characteristics, and their significance, of a "black box" amplifier including voltage gain, input resistance, output resistance, cut-off frequency, effect of loading on a signal source and effect of loading on the amplifier output.
- Analyze a small signal common emitter amplifier for both DC and AC conditions, including power distribution and power efficiency calculations.
- Describe the construction and operation of the Depletion MOSFET and the Enhancement MOSFET with particular attention to the differences between them.
- Draw the output characteristic curves and the transfer curve for the DMOS and EMOS transistors , demonstrating the bias requirements for EMOS switch and CMOS switch.

Assessment Weighting

Assessment	Weight
Exercise	
Assignments and Quizzes	15%
Final Exam	
Final Test	30%

Assessment	Weight
Midterm Exam	
Midterm Test	25%
Demonstration	
Laboratories	30%
Total	**100%**

Modules of Study

Module	Course Learning Outcomes	Resources	Assessments
SEMICONDUCTOR MATERIAL • Intrinsic semiconductor and the effect of temperature • N-type and P-type semiconductors • Majority and minority charge carriers • Electron-hole formation/recombination	• Analyze the effects of temperature on semiconductors by studying N type and P type semiconductor materials.		• Laboratories • Midterm Test • Final Test • Assignments and Quizzes
THE DIODE (PN JUNCTION) • Formation of the depletion region with no bias • Forward and reverse bias operation • The diode characteristic curve. • The effects of temperature under forward and reverse bias • Identifying all aspects of the diode data sheet	• Test a commercial semiconductor diode using an ohmmeter, after identifying the anode and cathode leads.		• Laboratories • Midterm Test • Final Test • Assignments and Quizzes
BASICS OF ALTERNATING CURRENT (AC) AND TRANSFORMERS • Sinusoidal waveforms and associated quantities • The 120 V supply and RMS voltage and current • Transformers. Windings: primary, secondary, number of turns • Step-down transformers. Center-tapped transformers	• Examine the operation of a bridge rectifier circuit complete with the required transformer and filter capacitor, including theoretical analysis and circuit testing.		• Laboratories • Midterm Test • Final Test • Assignments and Quizzes
DIODE CIRCUITS AND APPLICATIONS • Half- and full-wave rectifiers • Filter capacitor • Zener diode and the Zener voltage regulator circuit • Diode clippers and clampers	• Examine the operation of a bridge rectifier circuit complete with the required transformer and filter capacitor, including theoretical analysis and circuit testing. • Construct Zener diode voltage regulator circuits , including analysis and laboratory testing using standard test equipment and signal generators.		• Laboratories • Midterm Test • Final Test • Assignments and Quizzes

Module	Course Learning Outcomes	Resources	Assessments
THE FIELD EFFECT TRANSISTOR • The field effect. Construction and operation of FET, JFET, and MOSFET. Depletion MOSFET, Enhancement MOSFET, MESFETs • Output characteristic curves and transfer curve of FETs • EMOS bias requirements. • The basic EMOS switch; the CMOS switch. The IGBT.	• Describe the construction and operation of the Depletion MOSFET and the Enhancement MOSFET with particular attention to the differences between them. • Draw the output characteristic curves and the transfer curve for the DMOS and EMOS transistors , demonstrating the bias requirements for EMOS switch and CMOS switch.		• Laboratories • Midterm Test • Final Test • Assignments and Quizzes
THE BIPOLAR JUNCTION TRANSISTOR (BJT) • The construction of the NPN and PNP transistor • Bias requirements for normal transistor operation • Transistor currents, their relationship and transistor current gain BETA. • Transistor input and output characteristic curves • The DC load line and the meaning of active region, saturation, and cutoff • The effect of temperature on transistor operation • Identifying transistors and reading the transistor data sheet	• Describe the construction details, operation, data sheet specifications, effects of temperature, and operating characteristics of a BJT to establish a given operating point for BJT Switch, BJT class A, class B, class AB and class C amplifier circuits, demonstrating the circuit power and efficiency.		• Laboratories • Final Test • Assignments and Quizzes
THE BASIC TRANSISTOR SWITCH • Cutoff and Saturation Operation • Applications	• Design a basic BJT switch circuit to operate an LED, resistor load or relay coil.		• Laboratories • Final Test • Assignments and Quizzes
THE SMALL SIGNAL AMPLIFIER • Audio amplifier in a block diagram from power cord and microphone to speaker • Referencing the common emitter amplifier with voltage divider bias, capacitor coupling, and emitter bypass: • The DC and AC equivalent circuit • Calculating the DC bias conditions • Formulae for determining amplifier voltage gain, input resistance, and output resistance • The effect of signal source loading on the amplifier gain, and the effect of the output load on the amplifier gain. • The Emitter Follower amplifier	• Describe the important characteristics, and their significance, of a "black box" amplifier including voltage gain, input resistance, output resistance, cut-off frequency, effect of loading on a signal source and effect of loading on the amplifier output. • Analyze a small signal common emitter amplifier for both DC and AC conditions, including power distribution and power efficiency calculations.		• Laboratories • Final Test • Assignments and Quizzes

Module	Course Learning Outcomes	Resources	Assessments
THE POWER AMPLIFIER (CLASS B AND AB) • Power distribution and power efficiency in a common emitter amplifier • The classes of amplifier operation: A, B, AB, C. • The Class B amplifier: its operation, DC conditions, and crossover distortion • Power and efficiency • The class AB amplifier using diode (current mirror) bias • Darlington transistors in class B/AB amplifiers • Modular power amplifier.	• Describe the construction details, operation, data sheet specifications, effects of temperature, and operating characteristics of a BJT to establish a given operating point for BJT Switch, BJT class A, class B, class AB and class C amplifier circuits, demonstrating the circuit power and efficiency.		• Laboratories • Final Test • Assignments and Quizzes

Required Resources

Floyd, Thomas L. (2012). *Electronic Devices, Conventional Current Version (9th Ed.)*. Upper Saddle River, NJ: Prentice-Hall, ISBN 978-0-13-254986-8

Supplemental Resources

Floyd, T. L., & Buchla, D. M. (2020). Principles of Electric Circuits: Conventional Current Version (10th Ed.). Upper Saddle River, NJ: Pearson. ISBN: 9780134879482 (This is the standard text that is used in the fundamental DC and AC circuits courses).

Additional Tools and Equipment

- Electronics Parts Kit – mandatory for all students

Essential Skills

Section	Skills	Measurement	Details
Communication	• Reading • Writing • Speaking • Listening • Visual Literacy	Teach and measure	• Students will be guided on reading technical material in written and graphical format, then solving techincal problems. Students will engage in effective communication during class and lab exercises. • Faculty will evaluate through labs, assignments and tests.
Numeracy	• Understanding and applying mathematical concepts and reasoning • Analyzing and using numerical data • Conceptualizing	Teach and measure	• Students will be guided in solving technical problems that include detailed mathematical calculations and conceptualizing inherent behaviour of devices. • Faculty will evaluate through labs, assignments and tests.

Section	Skills	Measurement	Details
Critical Thinking and Problem-Solving	• Analysing • Synthesizing • Evaluating • Decision-Making • Creative and Innovative Thinking	Teach and measure	• Students will be guided on solving problems that meet a set of criteria yet have multiple solutions or pathways to the final solution. • Faculty will evaluate through labs, assignments and tests.
Information Management	•		•
Interpersonal Skills	• Teamwork • Relationship management • Conflict resolution	Teach and measure	• Students will be guided in-class exercises/take-home assignments that require groupwork in order to solve a given problem. • Faculty will evaluate through in-class exercises or take-home assignments.
Personal Skills	• Managing self • Managing change and being flexible and adaptable • Engaging in reflective practice • Demonstrating personal responsibility	Teach and measure	• Faculty will guide students in managing the course workload, and taking responsibility for completing all tasks. • Faculty will monitor student progress through regular course submissions as well as quizzes that ask the students to reflect on course material and their progress.

Prior Learning Assessment & Recognition (PLAR)

Prior Learning Assessment and Recognition (PLAR) is the formal evaluation and credit-granting process whereby candidates may obtain credits for prior learning. Prior learning includes the knowledge competencies and skills acquired, in both formal and informal ways, outside of post-secondary education. Candidates may have their knowledge, skills and competencies evaluated against the learning outcomes as defined in the course outline. Please review the Assessment Methods Glossary for more information on the Learning Portfolio assessment methods identified below.

The method(s) that are used to assess prior learning for this course may include:

- Challenge Exam (results recorded as a % grade and added to student's CGPA)
- Skills Test
- Interview

Please contact the Program Coordinator for more details.

Course Specific Policies and Expectations

A passing grade for this course is 50%. To get an overall passing grade in this course, students must independently pass the Test and the Lab/Assignment portions of the course. If one or more of these sections is less than 50% then the final grade for the course will be the lower of the two marks.

Academic Regulations

It is the student's responsibility to be aware of the College Academic Regulations. The Academic Regulations apply to all applicants to Humber and all current students enrolled in any program or course offered by Humber, in any location. Information about academic appeals is found in the **Academic Regulations**.

Anti-Discrimination Statement

At Humber College, all forms of discrimination and harassment are prohibited. Students and employees have the right to study, live and work in an environment that is free from discrimination and harassment. If you need assistance on concerns related to discrimination and harassment, please contact the Centre for Human Rights, Equity and Inclusion or the Office of Student Conduct.

Accessible Learning Services

Humber strives to create a welcoming environment for all students where equity, diversity and inclusion are paramount. Accessible Learning Services facilitates equal access for students with disabilities by coordinating academic accommodations and services. Staff in Accessible Learning Services are available by appointment to assess specific needs, provide referrals and arrange appropriate accommodations. If you require academic accommodations, contact:

Accessible Learning Services

North Campus: (416) 675-6622 X5090

Lakeshore Campus: (416) 675-6622 X3331

Academic Integrity

Academic integrity is essentially honesty in all academic endeavors. Academic integrity requires that students avoid all forms of academic misconduct or dishonesty, including plagiarism, cheating on tests or exams or any misrepresentation of academic accomplishment.

Disclaimer

While every effort is made by the professor/faculty to cover all material listed in the outline, the order, content, and/or evaluation may change in the event of special circumstances (e.g. time constraints due to inclement weather, sickness, college closure, technology/equipment problems or changes, etc.). In any such case, students will be given appropriate notification in writing, with approval from the Dean (or designate) of the School.

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See the **Humber Libraries website** for additional information regarding copyright and for details on allowable limits.
