ELECTRONICS & COMPUTER ENGINEERING DEPARTMENT

(COURSE OUTLINE)

ELEN 144 SEMICONDUCTOR DEVICES 1

This course is an introduction to semiconductor devices. It includes such topics ranging from semiconductor theory, diodes, transistors, and thyristors, to analogs IC's including op-amps and linear regulators. The focus of this course is in the application of these devices and troubleshooting circuits containing these devices.

OFFERED:	First Semester	
CREDIT:	4	
IN-CLASS WORKLOAD:	4 Lecture, 2 Lab for 14 weeks	
OUT-OF-CLASS WORKLOAD:	6	
PRE OR COREQUESITES:	ELEN 142	
INSTRUCTOR INFORMATION:	John Yang, 250-370-4213,	Room: TEC 268 yang@camosun.bc.ca

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OBJECTIVE:

Upon completion of this course, the student will have an understanding of commonly used analog electronic components and circuits.

OUTLINE:

1. Diodes (6 hrs)

- 1.1. The conductor and insulator
- 1.2. Doping –The semiconductor
- 1.3. N and P type materials
- 1.4. Biasing the PN Junction
- 1.5. Diode characteristics
- 1.6. Zener Diode characteristics
- 1.7. Light-emitting diodes
- 1.8. Photo diodes and laser diodes
- 1.9. Schottky diodes
- 1.10. Varactor, Tunnel and other miscellaneous diodes
- 1.11. Varistor and other commonly used diodes
- 1.12. Half and full wave rectifier circuits
- 1.13. Diode Applications

2. Introduction to Bipolar Transistors (BJTs) (4 hrs)

2.1. BJT construction
2.2. Biasing BJT's
2.3. BJT characteristics
2.4. Temperature effects on biasing voltages
2.5. Troubleshooting transistor bias circuits

3. Transistor AC Amplifiers (6 hrs)

3.1. Common emitter amplifier
3.2. Common collector amplifier
3.3. Common base amplifier
3.4. Class A amplifiers
3.5. Class B amplifiers
3.6. Class C amplifiers
3.7. Types of distortion

4. Field Effect Transistors (FETs) (6 hrs)

4.1. JFET characteristics
4.2. JFET biasing
4.3. JFET amplifiers
4.4. D type MOSFETs
4.5. E type MOSFETs
4.6. MOSFET amplifiers

5. Amplifier Frequency Response (4 hrs)

5.1. Low Frequency Amplifier Response
5.2. High Frequency Amplifier Response
5.3. Total Amplifier Frequency Response
5.4. Frequency Response of Multistage Amplifiers
5.5. Switching characteristics

6. Introduction to Operational Amplifiers (Op-Amps) (6 hrs)

6.1. Differential amplifier (with a pair of transistors)
6.2. Ideal Op-amps versus practical Op-amps
6.3. Block diagram versus integrated circuit
6.4. Op-amp characteristics - *signal mode, CMRR, impedance, slew rate, etc*.
6.5. Three basic Op-amp configurations
- Inverting input amplifier
- Non-inverting input amplifier
- Voltage follower

7. Op-Amp Circuit Applications (6 hrs)
- 7.1. Summing amplifier
- 7.2. Averaging amplifier
- 7.3. Scaling adder
- 7.4. Comparators
- 7.5. Active filters

8. Oscillators (6 hrs)
- 8.1. Feedback Oscillators
- 8.2. Wien bridge oscillator
- 8.3. RC phase shift oscillator
- 8.4. The Twin-T Oscillator
- 8.5. Colpitts oscillator
- 8.6. Harley and other oscillators
- 8.7. Crystal controlled oscillators
- 8.8. Relaxation oscillator

9. Unregulated and Regulated Power Supplies (6 hrs)
- 9.1. Zener regulator
- 9.2. Emitter follower regulator
- 9.3. Variable feedback regulator
- 9.4. Linear and Switching regulator
- 9.5. Other IC regulators
- 9.6. Basic power supply design
- 9.7. Determining power supply component values

10. Thyristors and Unijunction Devices (6 hrs)
- 10.1. Introduction to thyristors
- 10.2. Shockley diodes (or Four-layer diodes)
- 10.3. SCR characteristics
- 10.4. Diac's characteristics
- 10.5. Triac's characteristics
- 10.6. SCS, UJT, PUT, and IGBT

11. Miscellaneous Devices (as time permits)
- 11.1. Solar cells
- 11.2. Light-emitting diodes (LEDs)
- 11.3. Liquid crystal displays (LCDs)
- 11.4. Rechargeable batteries
- 11.5. Audio amplifier ICs
- 11.6. Motor control ICs

(Total In-Class Theory Hours *: **56 hours**)
** including quizzes, Midterm exam, and review time*

LABORATORY EXERCISES

There will be 13 lab exercises to be completed, one per week of the semester. Each exercise will be of 2 hours duration and all must be completed satisfactorily in order to gain a credit for ELEN 144. Labs will be available on D2L on Monday every week. Preparation must be completed by the student before the start of the lab.

(**Online Version**)

Lab 01	Get Ready for Online Labs with MULTISIM
Lab 02	Introduction to Diodes and Diode Characteristics
Lab 03	Zener Diodes and Their Characteristics
Lab 04	Introduction to Bipolar Junction Transistors (BJTs)
Lab 05	A Simple DC-biased BJT Amplifier Design
Lab 06	Voltage-divider Biased BJT Circuits
Lab 07	BJT ac Amplifiers
Lab 08	Introduction to Field-Effect Transistors (FETs)
Lab 09	FET Amplifiers Design
Lab 10	Introduction to Operational Amplifiers (Op-amps)
Lab 11	Op-amps Applications
Lab 12	Oscillator Circuits
Lab 13	Introduction to Voltage Regulation Circuits
Lab 14	Introduction to Thyristors Circuits

EVALUATION

Assignments/Quizzes	20%
Labs	20%
Midterm Exam	20%
Final Exam	40%
Total Course Mark	100%

GRADING (in accordance with the College policy)

A+	90 – 100%	**B-**	70 - 72%
A	85 – 89%	**C+**	65 - 69%
A-	80 – 84%	**C**	60 - 64%
B+	77 – 79%	**D**	50 - 59%
B	73 – 76%	**F**	< 50%

A minimum of 60% overall mark must be achieved in both the theory and lab portions to pass the course. Less than 60% overall mark in either portion will result in a failure of the entire course. In addition, to pass the course, the final examination mark must be not less than 50%.

The final grading is based on 80% of theory work, and 20% of lab evaluation. Lab evaluation will be based on completing all assigned exercises and lab reports. Labs are to be completed within the assigned lab period and evaluated as satisfactory or unsatisfactory. Any unsatisfactory lab reports must be redone until a satisfactory level is achieved.

Attendance and completion of all lab material is mandatory to complete the course. Attendance at all tutorials is also compulsory.

Quizzes may be given at any time without prior notice and will be based on the current class notes, example problems and any textbook reading assigned.

TEXTS AND REFERENCES

- **Electronic Devices** 6th Edition (or newer)
  Floyd Thomas L. ISBN 0-13-028484-X

- **Laboratory Exercises, Handouts and Course Outline**
  Typically available both online and in class

Optional Book available: (Used for ELEN 142 – Circuit Analysis)

- **Circuit Analysis with Devices** 2nd Edition (or newer)
  Robbins and Miller ISBN 140187984-5