

CAMOSUN COLLEGE
ELECTRONICS ENGINEERING DEPARTMENT
COURSE OUTLINE

CALENDAR DESCRIPTION

ELEN 145 POWER DEVICES AND SYSTEMS

This course covers the application of various power devices such as thyristors (such as diacs, triacs, SCR's) and their use in various systems such as drive systems, power supplies, control, etc.

OFFERED:	3rd Quarter
CREDIT:	3
IN-CLASS WORKLOAD (hours):	3 (lecture), 2 (lab)
PREREQUISITES:	ELEN 141 and ELEN 144

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OBJECTIVES:

On completion of this course, students will have an understanding of how power devices are used in industrial applications including speed control of both DC and AC motors. Various lab exercises are carried out to reinforce this material.

OUTLINE:

I. INTRODUCTION TO POWER ELECTRONICS **1 HR**

- 1.1 Why power devices?
- 1.2 Applications of power electronics - Examples

II. SOLID STATE POWER DEVICES **5 HRS**

- 2.1 General Purpose Rectifier Diodes
- 2.2 Switching Characteristics
- 2.3 Forward switching characteristics
- 2.4 Reverse Recovery Time
- 2.5 Schottky Diodes. Reverse recovery time
- 2.6 Switching power losses
- 2.7 Series Connected Diodes
- 2.8 Parallel Connected Diodes
- 2.9 Power switches
- 2.10 BJT power transistors. Power MOSFETs
- 2.11 Insulated Gate Bipolar transistors (IGBT)

III. SOLID STATE UNIDIRECTIONAL POWER CONTROL DEVICES

4 HRS

- 3.1 SCR Thyristors-Characteristics-Holding and Latching current
- 3.2 Thyristor commutation- (Gate power). Gate turnoff (GTO) thyristors
- 3.3 Examination Of An RDL Circuit
- 3.4 Frequency And Switching Speed
- 3.5 Rate Of Change Of Anode Current
- 3.6 Rate Of Change Of Anode To Cathode Voltage
- 3.7 SCR in commutation.
- 3.8 GTO's
- 3.9 SCR firing circuits.
- 3.10 Gate triggering
- 3.11 Phase-angle firing

IV. UNIUNCTION TRANSISTOR

4 HRS

- 4.1 Calculating The Frequency And Time Delay
- 4.2 Programmable UJT
- 4.3 Programmable UJT - Applications

V. SOLID STATE BIDIRECTIONAL POWER DEVICES

3 HRS

- 5.1 Diac – Switching properties
- 5.2 Triac- Switching properties.
- 5.3 Triac circuits and calculations
- 5.4 Use of diac to switch triacs

VI. PROTECTION DEVICES

2 HRS

- 6.1 Cooling + heat sinks
- 6.2 Snubber circuits
- 6.3 Voltage and current protection devices

VII. SOLID STATE RELAYS

1 HR

- 7.1. Different types of relays (electromagnetic , solid state)
- 7.2 Examples

VIII. ZERO VOLTAGE CONTROL

1 HR

- 9.1 Effect of switching
- 9.2 Techniques used to avoid harmonics interference from switching

IX. DC MOTOR CONTROL

3 HRS

- 10.1 H Bridge
- 10.2 Half And Full Wave Control
- 10.3 Jones Chopper
- 10.4 Pulse Width Modulation
- 10.5 Closed Loop Speed Control

<u>X. MOTORS</u>	3 HRS
11.1 Introduction	
11.2 DC motors	
11.3 AC motors – Synchronous and squirrel cage induction	
11.4 AC motor speed control	
11.5 Universal motors and their speed control	
11.6 Stepper motors	
<u>XI. ADJUSTABLE FREQUENCY AC DRIVES</u>	2 HRS
12.1 Variable Voltage Inverter	
12.2 Current Source Inverter	
12.3 Pulse Width Modulating Inverter	
12.4 Cycloconverter	
<u>XII. DC/DC SWITCHING SUPPLIES</u>	3 HRS
13.1 Buck Converter	
13.2 Boost Converter	
13.3 Buck - Boost Converter	
<u>XIII. VOLTAGE MULTIPLIER</u>	1 HR
14.1 Voltage Doubler	
14.2 Voltage Tripler	
<u>XIV. UNINTERRUPTIBLE POWER SUPPLIES</u>	2 HRS
15.1 UPS Components	
15.2 ON-Line System	
15.3 OFF-Line System	
<u>TESTS AND REVIEW</u>	7 HRS
<u>TOTAL</u>	42 HRS

TEXT AND REFERENCES:

Industrial Electronics, Humphries and Sheets, ISBN 0-8273-5825-3.

GRADING

In accordance with Department and College policies.

EVALUATION (100%)

Labs	20%
Problem sets	10%
Tests	25%
Final Exam	45%

ELEN 145 Laboratory List

1. POWER DIODES CHARACTERISTICS
2. RECOVERY TIME OF POWER DIODES
3. IGBT SWITCHING CHARACTERISTICS
4. SCR CHARACTERISTICS
5. DC POWER CONTROL USING AN SCR
6. RELAXATION OSCILLATOR
7. The Programmable Uni-junction TRANSISTOR as a Thyristor triggering device
8. TRIAC / DIAC PRINCIPLES
9. TRIAC PHASE CONTROL
10. SOLID STATE RELAY
11. H BRIDGES
12. UNIVERSAL MOTOR SPEED CONTROLLER
13. PWM or Actuators