

SAULT COLLEGE OF APPLIED ARTS & TECHNOLOGY

SAULT STE. MARIE, ONTARIO

COURSE OUTLINE

COURSE TITLE: POWER ELECTRONIC SYSTEMS
CODE NO.: ELR317 - 3
PROGRAM: ELECTRICAL TECHNOLOGY
SEMESTER: FIVE
DATE: SEPTEMBER 1988
AUTHOR: ENO LUDAVICIUS

NEW: _____ REV.: X

APPROVED:

J.P. Crozatt
CHAIRPERSON

90/08/15
DATE

CALENDAR DESCRIPTION

POWER ELECTRONIC SYSTEMS
COURSE NAME

ELR317 - 3
COURSE NUMBER

PHILOSOPHY/GOALS:

TO CONTINUE POWER ELECTRONIC DEVICES WHERE THE STUDENT APPLIES INVERTER THEORY TO POWER ELECTRONIC SYSTEMS IN THE LAB ENVIRONMENT. ALSO THE STUDENT WILL BE INTRODUCED TO POWER SYSTEM FUNDAMENTALS AND POWER DISTRIBUTION TECHNIQUES AND MEASUREMENT.

METHOD OF ASSESSMENT (GRADING METHOD):

THE STUDENT WILL BE ASSESSED IN THE FOLLOWING MANNER:

- 1) TWO WRITTEN TESTS WORTH 30% EACH.
- 2) PROJECTS AND ASSIGNMENTS WORTH 40% IN TOTAL.

TEXTBOOK(S):

- 1) ELECTRICAL POWER TECHNOLOGY - T. WILDI
- 2) POWER ELECTRONICS & CONTROLS - S.K. DATTA
- 3) POWER CONTROL WITH SOLID-STATE DEVICES - I.M. GOTTLIEB
- 4) POWER ELECTRONICS - SOLID STATE MOTOR CONTROL - R.A. PEARMAN
- 5) POWER ELECTRONICS- CIRCUITS, DEVICES, APPLICATIONS- M.H.RASHID
- 6) ELECTRICAL TRANSFORMERS AND POWER EQUIPMENT - A.J. PANSINI
- 7) ELECTRICAL POWER SYSTEM TECHNOLOGY - S.W.FARDO & D.R.PATRICK

POWER ELECTRONIC SYSTEMS

GENERAL OBJECTIVES

1) BLOCK 1 - POWER ELECTRONIC DEVICES OVERVIEW

- 1.1) DEVICE CHARACTERISTICS
- 1.2) DATA SHEETS
- 1.3) DEVICE PROTECTION
- 1.4) PHASE-CONNECTED CONVERTERS

2) BLOCK 2 - INVERTER SYSTEMS

- 2.1) LINE COMMUTATED INVERTER OVERVIEW
- 2.2) DC LINK INVERTERS
- 2.3) CYCLOCONVERTERS
- 2.4) INVERTER INDUSTRIAL APPLICATIONS

3) BLOCK 3 - A.C. MACHINE CONTROL

- 3.1) INTRODUCTION TO A.C. MACHINE CONTROL
- 3.2) INDUCTION MOTOR DRIVES
- 3.3) SYNCHRONOUS MOTOR DRIVES
- 3.4) RELUCTANCE & STEPPER MOTOR DRIVES
- 3.5) DRIVE CONSIDERATIONS

4) BLOCK 4 - POWER SYSTEM FUNDAMENTALS

- 4.1) INTRODUCTION TO MODERN AD/DC ELECTRICAL POWER SYSTEMS
- 4.2) POWER DISTRIBUTION FUNDAMENTALS & EQUIPMENT
- 4.3) POWER CONTROL & CONVERSION SYSTEMS
- 4.4) POWER MEASUREMENT FUNDAMENTALS & MEASURING DEVICES

POWER ELECTRONIC SYSTEMS

SPECIFIC OBJECTIVES

1) BLOCK 1 - POWER ELECTRONIC DEVICES OVERVIEW

1.1) DEVICE CHARACTERISTICS

REVIEW OF THE CHARACTERISTICS OF SCR'S:

- PHASE CONTROLLED AND INVERTER GRADE
- AMPLIFYING GATE
- GATE TURN-OFF THYRISTORS (GTO)
- LIGHT ACTIVATED
- REVERSE CONDUCTING THYRISTORS (RCT)
- TRIACS
- NPN POWER TRANSISTORS
- POWER MOSFETS
- GENERAL PURPOSE & FAST ACTING RECTIFIER DIODES

1.2) DATA SHEETS

TO UNDERSTAND MANUFACTURES DATA SHEETS AND BE ABLE TO SELECT THE APPROPRIATE DEVICES FOR ANY SPECIFIC APPLICATION.

1.3) DEVICE PROTECTION

- JUNCTION TEMPERATURE; TURN-ON CONDUCTION AND TURN-OFF HEAT DISSIPATION COMPONENTS.
- EFFECTS OF SWITCHING RATES
- THERMAL IMPEDANCES & TRANSIENT THERMAL IMPEDANCE
- HEAT SINK CALCULATIONS
- SELECTION OF DEVICE PACKAGE AND TYPE OF HEAT SINK
- THERMOCAPACITY
- PULSE AND SURGE CURRENT CAPABILITIES
- CURRENT RATINGS
- TURN-ON di/dt
- TRANSIENT OVERVOLTAGE
- OFF-STATE dv/dt
- SERIES/PARALLEL ARRAYS FOR HIGH-POWER APPLICATIONS

ELR317 - 3

POWER ELECTRONIC SYSTEMS

SPECIFIC OBJECTIVES

1) BLOCK 1 - POWER ELECTRONIC DEVICES OVERVIEW

1.4) PHASE-CONNECTED CONVERTERS

- 1) SINGLE-PHASE CONVERTERS: LOAD VOLTAGE AND HARMONICS, DISTORTION FACTOR, DISPLACEMENT FACTOR, POWER FACTOR, DISCONTINUOUS CONDUCTION.
- 2) THREE PHASE CONVERTERS: HARMONICS AND DISPLACEMENT FACTOR, COMMUTATION OVERLAP, SEMICONVERTER, DUAL CONVERTERS.
- 3) CONVERTER CONTROL: LINEAR FIRING ANGLE CONTROL, COSINE CROSSING CONTROL, DIGITAL FIRING CIRCUITS, PHASE-LOCKED-LOOP AND MICROPROCESSOR CONTROL.

2) BLOCK 2 - INVERTER SYSTEMS

2.1) LINE COMMUTATED INVERTER OVERVIEW

VOLTAGE-FED INVERTERS

- 1) SQUARE-WAVE INVERTER: INPUT RIPPLE, VOLTAGE AND CURRENT RATINGS, TWELVE-STEP INVERTER.
- 2) VOLTAGE AND FREQUENCY CONTROL.
- 3) COMMUTATION METHODS: McMURRAY, McMURRAY-BEFFORD AND VERHOEF INVERTERS, AC SWITCHED AND DC SIDE COMMUTATED INVERTERS.
- 4) PWM INVERTERS: SINUSODIAL PWM, HARMONIC ELIMINATION, MINIMUM RIPPLE CURRENT CONTROL, ADAPTIVE CURRENT CONTROL PWM, PHASE SHIFT PWM, DYAMMIC AND REGENERATIVE BREAKING CONTROL CIRCUITS.

CURRENT-FED INVERTERS

- 5) GENERAL OPERATION, INVERTER OPERATION MODES.
- 6) LOAD COMMUTATED INVERTERS: SINGLE-PHASE & THREE-PHASE.
- 7) SYNCHRONOUS MOTOR STARTING.
- 8) FORCE COMMUTATED INVERTERS: AUTO-SEQUENTIAL-COMMUTATED INVERTER (ASCI), TORQUE PULSATION, AUXILIARY-BRIGDE-COMMUTATED INVERTER, INVERTER WITH FOURTH LEG COMMUTATION.
- 9) TWELVE-STEP INVERTER.
- 10) CURRENT-FED VERUS VOLTAGE-FED INVERTERS.