

**SAULT COLLEGE OF APPLIED ARTS & TECHNOLOGY**

**SAULT STE. MARIE, ONTARIO**

**COURSE OUTLINE**

**COURSE OUTLINE:** MICROWAVE AND SATELLITE COMMUNICATIONS  
**CODE NO.:** ELN316-5  
**PROGRAM:** ELECTRONICS TECHNICIAN/TECHNOLOGY  
**SEMESTER:** SIX  
**DATE:** JANUARY 1994  
**PREVIOUS OUTLINE DATED:** JANUARY 1993  
**AUTHOR:** DOUG FAGGETTER

**NEW:** \_\_\_\_\_ **REV.:**   A  

**APPROVED:**

W. Filipowich  
**COORDINATOR**

Jan 11/94  
**DATE**

L. B. Chayetta  
**DEAN**

94-01-10  
**DATE**

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**TOTAL CREDIT HOURS:** 5

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**PREREQUISITE(S):** ELN245, ELR309

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**PHILOSOPHY/GOALS:**

THIS COURSE WILL GIVE THE STUDENT A THOROUGH KNOWLEDGE OF THEORY AND OPERATION OF PASSIVE AND ACTIVE COMPONENTS EMPLOYED IN MICROWAVE EQUIPMENT. LABORATORY WORK INCLUDES THE EXPERIMENTAL GENERATION OF MICROWAVE SIGNALS AND THEIR TESTING WITH WAVEGUIDE HARDWARE. ALSO INCLUDED ARE MICROWAVE CIRCUIT CONSTRUCTION PROJECTS.

**STUDENT PERFORMANCE OBJECTIVES:**

UPON SUCCESSFUL COMPLETION OF THIS COURSE, THE STUDENT WILL:

1. HAVE A FUNDAMENTAL KNOWLEDGE OF ELECTROMAGNETIC FIELD THEORY AND BE ABLE TO APPLY IT TO THE SOLUTION OF TRANSMISSION LINE PROBLEMS.
2. UNDERSTAND THE OPERATION OF WAVEGUIDES AND APPLY FORMULAS TO THE SOLUTION OF PROBLEMS.
3. BE ABLE TO USE THE SMITH CHART IN THE SOLUTION OF TRANSMISSION LINE PROBLEMS.
4. HAVE OF FUNDAMENTAL KNOWLEDGE OF MICROWAVE NETWORK PARAMETERS AND APPLY IT TO THE SOLUTION OF PROBLEMS.
5. BE FAMILIAR WITH VARIOUS TYPES OF MICROWAVE COMPONENTS AND HOW THEY OPERATE.
6. BE FAMILIAR WITH VARIOUS TYPE OF MICROWAVE TUBES AND HOW THEY OPERATE.
7. BE FAMILIAR WITH VARIOUS TYPES OF MICROWAVE ANTENNAS AND HOW THEY OPERATE.

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**TOPICS TO BE COVERED:**

1. INTRODUCTION TO MICROWAVES
2. CIRCUITS AND FIELDS
3. TRANSMISSION LINES
4. WAVEGUIDES AND RESONATORS
5. SMITH CHART
6. MICROWAVE NETWORK PARAMETERS
7. SOLID-STATE MICROWAVE DEVICES
8. MICROWAVE COMPONENTS
9. MICROWAVE TUBES
10. ANTENNAS
11. SATELLITE COMMUNICATIONS

**REQUIRED TEXTBOOK:**

MICROWAVE THEORY COMPONENTS AND DEVICES  
BY- JOHN A. SEEGER  
(PRENTICE HALL 1986)

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**LEARNING ACTIVITIES**

**REQUIRED RESOURCES**

1 INTRODUCTION

TEXT: CHAPTER 1

- 1.1 MICROWAVE FREQUENCIES
- 1.2 HISTORY
- 1.3 APPLICATION OF MICROWAVES
- 1.4 UNITS
- 1.5 CO-ORDINATE SYSTEMS

2 CIRCUITS AND FIELDS

TEXT: CHAPTER 2

- 2.1 CIRCUIT THEORY
- 2.2 ELECTROMAGNETIC FIELDS
- 2.3 HIGH FREQUENCY EFFECTS

3 TRANSMISSION LINES

TEXT: CHAPTER 3

- 3.1 STEP INPUT TO A TRANSMISSION LINE
- 3.2 AC SOLUTION FOR A TRANSMISSION LINE

4 WAVEGUIDES AND RESONATORS

TEXT: CHAPTER 4

- 4.1 TRANSVERSE ELECTRIC MODES IN A RECTANGULAR WAVEGUIDE
- 4.2 POWER IN A RECTANGULAR WAVEGUIDE
- 4.3 TRANSVERSE MAGNETIC MODES IN A RECTANGULAR WAVEGUIDE
- 4.4 CIRCULAR WAVEGUIDES
- 4.5 WAVEGUIDE CAVITIES

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**LEARNING ACTIVITIES**

**REQUIRED RESOURCES**

5 SMITH CHART

- 5.1 DETERMINATION OF INPUT IMPEDANCE
- 5.2 USE OF THE SMITH CHART WITH ADMITTANCE
- 5.3 SINGLE STUB MATCHING USING THE SMITH CHART
- 5.4 DOUBLE STUB MATCHING
- 5.5 DETERMINING IMPEDANCE USING THE SMITH CHART AND THE SLOTTED LINE
- 5.6 SMITH CHART AND POWER
- 5.7 LOSSY LINES
- 5.8 FREQUENCY AND THE SMITH CHART

TEXT: CHAPTER 6

6 MICROWAVE NETWORK PARAMETERS

- 6.1 TWO PORT PARAMETERS
- 6.2 ABCD PARAMETERS
- 6.3 SCATTERING PARAMETERS
- 6.4 PROPERTIES OF S-PARAMETERS
- 6.5 CHANGE OF PORT POSITION
- 6.6 SCATTERING TRANSFER PARAMETERS
- 6.7 SIGNAL FLOW GRAPHS

TEXT: CHAPTER 7

7 MICROWAVE COMPONENTS

- 7.1 COAXIAL LINES
- 7.2 WAVEGUIDE SECTIONS
- 7.3 WAVEGUIDE REACTIVE ELEMENTS
- 7.4 TERMINATIONS
- 7.5 ATTENUATORS
- 7.6 PHASE SHIFTER
- 7.7 WAVEGUIDE TEES
- 7.8 MAGIC TEES
- 7.9 DIRECTIONAL COUPLER
- 7.10 ISOLATOR
- 7.11 CIRCULATOR

TEXT: CHAPTER 8

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**LEARNING ACTIVITIES**

**REQUIRED RESOURCES**

8 SOLID-STATE MICROWAVE DEVICES

- 8.1 SEMICONDUCTOR CONCEPTS
- 8.2 MICROWAVE APPLICATIONS OF SEMI-CONDUCTOR DIODES
- 8.3 PASSIVE DIODE DEVICES
- 8.4 MICROWAVE TRANSISTORS

TEXT: CHAPTER 11

9 MICROWAVE TUBES

- 9.1 LINEAR BEAM MICROWAVE TUBES
- 9.2 CROSSED-FIELD TUBES
- 9.3 MILLIMETER-WAVE TUBES

TEXT: CHAPTER 10

10 ANTENNAS

- 10.2 PROPERTIES OF ANTENNAS
- 10.2 DIPOLE ANTENNA
- 10.3 HORN ANTENNA
- 10.4 PARABOLIC REFLECTOR ANTENNAS
- 10.5 LENS ANTENNA
- 10.6 SLOT ANTENNA
- 10.7 POLYROD ANTENNA
- 10.8 HELICAL ANTENNA
- 10.9 FREQUENCY-INDEPENDENT ANTENNA
- 10.10 ANTENNA ARRAYS

TEXT: CHAPTER 9

11 SATELLITE COMMUNICATIONS

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**EVALUATION PROCEDURES**

1. TESTING WILL CONSIST OF BOTH THEORY AND PRACTICAL COMPONENTS. AT LEAST ONE WEEK NOTICE WILL BE GIVEN FOR ALL MAJOR TESTS.

2. QUIZZES MAY BE GIVEN FROM TIME TO TIME WITHOUT NOTICE.

3. THE GRADING WEIGHT WILL BE:

THEORY	-	70%
LAB	-	30%
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TOTAL	-	100%

4. THE GRADING SYSTEM WILL BE AS FOLLOWS:

A+	=	90	-	100%
A	=	80	-	90%
B	=	70	-	79%
C	=	55	-	69%
R	=	REPEAT		

5. THE STUDENT MUST ATTAIN A 55% IN BOTH THEORY AND LAB PORTIONS TO SUCCESSFULLY COMPLETE THE COURSE.

**SPECIAL NOTES:**

1. LAB ATTENDANCE IS COMPULSORY AND IS INCLUDED IN THE EVALUATION PROCESS.

2. THE INSTRUCTOR RESERVES THE RIGHT TO MODIFY THE COURSE TO MEET THE NEEDS OF THE STUDENTS.

