

SAULT COLLEGE OF APPLIED ARTS & TECHNOLOGY

SAULT STE. MARIE, ONTARIO

COURSE OUTLINE

COURSE TITLE: ELECTRICAL FUNDAMENTALS

CODE NO.: ELR 100 - 5

PROGRAM: ELECTRICAL/ELECTRONIC SEMESTER: 1

AUTHOR: *A. Goodenhan*

DATE: *Aug 1993* PREVIOUS OUTLINE DATED: MAY, 1991

APPROVED:

COORDINATOR

DATE

DEAN

DATE

ELECTRICAL FUNDAMENTALS
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TOTAL CREDIT HOURS: 80

PREREQUISITE(S):

I. PHILOSOPHY/GOALS:

AN INTRODUCTION TO ELECTRICAL QUANTITIES AND UNITS; OHM'S AND KIRCHHOFF'S LAWS; SIMPLE DC SERIES, PARALLEL, SERIES PARALLEL, AND VOLTAGE DIVIDER CIRCUITS; SIMPLE DC NETWORK ANALYSIS; MAGNETISM AND ELECTROMAGNETISM; INDUCTANCE AND CAPACITANCE; SINE WAVE CHARACTERISTICS AND PHASORS; BASIC SERIES AND PARALLEL RLC CIRCUIT ANALYSIS.

II. STUDENT PERFORMANCE OBJECTIVES:

UPON SUCCESSFUL COMPLETION OF THIS COURSE THE STUDENT WILL:

1. HAVE A FUNDAMENTAL KNOWLEDGE OF AC AND DC CIRCUIT THEORY;
2. BE ABLE TO SIMPLIFY AND ANALYZE BASIC AC AND DC CIRCUITS COMPRISED OF RESISTORS, CAPACITORS AND INDUCTORS;
3. UNDERSTAND BASIC MAGNETISM AND ELECTROMAGNETISM;
4. USE PHASORS AND COMPLEX NUMBERS TO ASSIST IN ANALYSIS OF AC CIRCUITS.

III. TOPICS TO BE COVERED:

1. ELECTRICAL UNITS;
2. CONDUCTORS AND INSULATORS;
3. SERIES CIRCUITS;
4. PARALLEL CIRCUITS;
5. SERIES-PARALLEL CIRCUITS;
6. NETWORK THEOREMS;
7. MAGNETISM;
8. MAGNETIC CIRCUITS;
9. INDUCTANCE;
10. CAPACITANCE;
11. ALTERNATING CURRENT FUNDAMENTALS;
12. AC CIRCUIT ANALYSIS.

IV. LEARNING ACTIVITIES

REQUIRED RESOURCES

TEXT: FUNDAMENTALS OF
ELECTRIC CIRCUITS,
4th EDITION, BELL.

1. ELECTRICAL UNITS
 - ELECTRIFICATION BY FRICTION
 - PLANETARY ATOM
 - POTENTIAL DIFFERENCE, CURRENT AND RESISTANCE
 - BASIC SOURCE OF ELECTRICITY
 - ELECTRIC LAMP
 - ELECTRIC CIRCUIT
 - CIRCUIT DIAGRAMS
 - CURRENT DIRECTION
 - DIRECT CURRENT AND ALTERNATING CURRENT
 - ELECTRIC SHOCK
 - SCIENTIFIC NOTATION, METRIC PREFIXES, ENGINEERING NOTATION
 - RESISTANCE AND CONDUCTANCE
 - OHM'S LAW
 - APPLICATION OF OHM'S LAW
 - ELECTRICAL POWER AND ENERGY

2. CONDUCTORS AND INSULATORS
 - ATOMIC BONDING
 - INSULATORS
 - CONDUCTORS
 - CONDUCTOR RESISTIVITY
 - TEMPERATURE EFFECTS ON CONDUCTORS
 - RESISTORS

3. SERIES CIRCUITS
 - CURRENT IN A SERIES CIRCUIT
 - VOLTAGES IN A SERIES CIRCUIT
 - VOLTAGE DIVIDERS
 - POTENTIOMETERS
 - POWER IN A SERIES CIRCUIT
 - VOLTAGE DROPPING AND CURRENT LIMITING
 - OPEN AND SHORT CIRCUITS IN A SERIES CIRCUIT

CH.1,3

CH.4

CH.5

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| LEARNING ACTIVITIES | REQUIRED RESOURCES |
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| 4. PARALLEL CIRCUITS - VOLTAGE AND CURRENT IN A PARALLEL CIRCUIT - PARALLEL EQUIVALENT CIRCUITS - CONDUCTANCES IN PARALLEL - CURRENT DIVIDER - POWER IN PARALLEL CIRCUITS - OPEN AND SHORT CIRCUITS IN A PARALLEL CIRCUIT | CH.6 |
| 5. SERIES-PARALLEL CIRCUITS - EQUIVALENT CIRCUIT OF A SERIES-PARALLEL CIRCUIT - CURRENTS IN A SERIES-PARALLEL CIRCUIT - VOLTAGE DROPS IN A SERIES-PARALLEL CIRCUIT - OPEN AND SHORT CIRCUITS IN A SERIES-PARALLEL CIRCUIT - ANALYSIS OF SERIES-PARALLEL CIRCUITS | CH.7 |
| 6. NETWORK THEOREMS - VOLTAGE AND CURRENT SOURCES - NETWORK ANALYSIS USING KIRCHHOFF'S LAWS - THE SUPERPOSITION THEOREM - THEVENIN'S THEOREM - NORTON'S THEOREM | CH.8,9 |
| 7. MAGNETISM - MAGNETIC FIELD - ELECTROMAGNETISM - THEORY OF MAGNETISM - MAGNETIC FLUX AND FLUX DENSITY - MAGNETOMOTIVE FORCE AND MAGNETIC FIELD STRENGTH - FORCE ON A CURRENT-CARRYING CONDUCTOR IN A MAGNETIC FIELD | CH.11 |
| 8. MAGNETIC CIRCUITS - RELUCTANCE AND PERMEABILITY - PERMEABILITY OF FREE SPACE - SOLENOIDS - RELATIVE PERMEABILITY - MAGNETIZATION CURVES - HYSTERESIS - EDDY CURRENTS | CH.12 |

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| LEARNING ACTIVITIES | REQUIRED RESOURCES |
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| 9. INDUCTANCE - ELECTROMAGNETIC INDUCTION - INDUCED EMF AND CURRENT - SELF-INDUCTANCE - MUTUAL INDUCTANCE - TYPES OF INDUCTORS - ENERGY STORED IN AN INDUCTOR - INDUCTORS IN SERIES AND IN PARALLEL - STRAY INDUCTANCE - LR CIRCUITS | CH.14,16 |
| 10. CAPACITANCE - ELECTRIC CHARGE STORAGE - ELECTRIC FIELD - CAPACITANCE AND CAPACITOR DIMENSIONS - CAPACITOR TYPES AND CHARACTERISTICS - CAPACITORS IN SERIES AND IN PARALLEL - ENERGY STORED IN A CAPACITOR - STRAY CAPACITANCE - RC CIRCUITS | CH.15,16 |
| 11. ALTERNATING CURRENT FUNDAMENTALS - GENERATION OF ALTERNATING VOLTAGE - SINE WAVE - FREQUENCY, PHASE ANGLE, AND WAVELENGTH - RESISTIVE LOAD WITH AC SUPPLY - PEAK, AVERAGE AND RMS VALUES - CATHODE RAY OSCILLOSCOPES | CH.17 |
| 12. AC CIRCUIT ANALYSIS - PHASORS AND COMPLEX NUMBERS - POLAR AND RECTANGULAR NOTATION - SERIES, PARALLEL, AND SERIES-PARALLEL RLC CIRCUITS - RESONANCE | CH.18, 19 |

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V. EVALUATION METHODS

FOUR (4) TESTS WORTH 25% EACH

TOTAL 100%

THE GRADING SYSTEM USED WILL BE AS FOLLOWS:

A+= 90 - 100% A= 80 - 89% B= 70 - 79% C= 55 - 69

R= REPEAT

NOTES: IF A STUDENT MISSES A TEST HE/SHE MUST HAVE A VALID REASON (ie. MEDICAL OR FAMILY EMERGENCY). IN ADDITION THE SCHOOL MUST BE NOTIFIED BEFORE THE SCHEDULED TEST SITTING. THE STUDENT SHOULD CONTACT THE INSTRUCTOR INVOLVED. IF THE INSTRUCTOR CANNOT BE REACHED LEAVE A MESSAGE WITH THE DEAN'S OFFICE OR THE COLLEGE SWITCHBOARD. IF THIS PROCEDURE IS NOT FOLLOWED THE STUDENT WILL RECEIVE A MARK OF ZERO ON THE TEST WITH NO REWRITE OPTION.

STUDENTS WILL BE GIVEN ADVANCE NOTICE OF TEST DATES (1 WEEK MINIMUM). QUIZZES (WORTH A MAXIMUM OF 5%) MAY BE GIVEN WITHOUT NOTICE. THERE WILL BE NO REWRITES FOR STUDENTS MISSING QUIZZES WITHOUT PRIOR NOTICE AND VALID REASONS.

VI. REQUIRED STUDENT RESOURCES:

TEXT BOOKS: FUNDAMENTALS OF ELECTRIC CIRCUITS, FOURTH EDITION BY D. A. BELL. PRENTICE HALL, 1988.

VII. ADDITIONAL RESOURCE MATERIALS AVAILABLE IN THE COLLEGE LIBRARY BOOK SECTION:

VIII. SPECIAL NOTES:

SUGGESTED READINGS AND PROBLEMS FOR ELR 100 (BELL TEXT)

LECTURE (ACTIVITIES LISTED SHOULD BE STARTED AROUND THE TIME OF THE INDICATED LECTURE AND DEPENDING ON THE LENGTH OF THE ASSIGNMENT COMPLETED IN A WEEK OR LESS. THIS IS A ROUGH GUIDELINE ONLY. REVIEW QUESTIONS LISTED SHOULD BE READ OVER AND IF YOU DO NOT KNOW THE ANSWER REVIEW THE APPROPRIATE TEXT SECTIONS. IT IS PROBABLY NOT NECESSARY TO WRITE OUT THE ANSWERS. I WOULD SUGGEST THAT THE END OF CHAPTER PROBLEM SOLUTIONS BE WRITTEN OUT IN FULL.)

- 1 READ CH. 1 AND APPENDIX 2
- 2 CH. 1 REVIEW QUESTIONS: 1 TO 7, 10, 11, 13, 14, 16.
READ CHAPTERS 3 AND 4.
CH. 3 REVIEW QUESTIONS: ALL.
CH. 3 PROBLEMS: 1a, 1d, 2a, 2c, 4, 5, 7, 13, 15, 19,
21, 24, 27.
CH. 4 REVIEW QUESTIONS: ALL.
- 6 CH. 4 PROBLEMS: 3, 7, 11, 13, 15, 19, 21, 29, 31, 33,
35, 37.
- 8 READ CHAPTER 5.
CH. 5 REVIEW QUESTIONS: ALL.
CH. 5 PROBLEMS: 1, 3, 4, 7, 9, 11, 13, 16, 17, 19, 27,
33.
- 14 READ CHAPTER 6.
CH. 6 REVIEW QUESTIONS: ALL.
CH. 6 PROBLEMS: 1, 5, 7, 9, 13, 19, 21, 23, 27, 29.
- 18 READ CHAPTER 7.
CH. 7 PROBLEMS: 1, 3, 5, 7, 9, 11, 17, 19, 22, 24, 25,
32, 33.
- 25 READINGS CHAPTER 8: INTRODUCTION, SECTION 1 UP TO BUT
NOT INCLUDING SOURCE CONVERSIONS,
SECTIONS 2 AND 3.
CH. 8 PROBLEMS: 9, 11, 13, 19, 21, 23.
- 26 READINGS CHAPTER 9: INTRODUCTION, SECTIONS 1, 2, 3.
CH. 9 REVIEW QUESTIONS: 1, 2, 3.
CH. 9 PROBLEMS: 1, 3, 5, 7, 9, 11, 13, 15, 17, 23.
- 37 READ CHAPTER 11.
CH. 11 REVIEW QUESTIONS: ALL
CH. 11 PROBLEMS: 1, 5, 11, 13, 15, 17, 19, 23.
- 42 READ CHAPTER 12 EXCLUDING SECTIONS 5 AND 6.
CH. 12 REVIEW QUESTIONS: 1, 4, 7, 9, 10.
CH. 12 PROBLEMS: 1, 3, 5, 7, 9, 11, 13, 15.

- 48 READ CHAPTER 14.
CH. 14 REVIEW QUESTIONS: 1, 2, 3, 4, 12, 15.
CH. 14 PROBLEMS: 1, 3, 9, 11, 19, 21, 25, 31.
- 52 READINGS CHAPTER 16: INTRODUCTION, SECTIONS 1 TO 4.
CH. 16 REVIEW QUESTIONS: 1, 2, 3, 4.
CH. 16 PROBLEMS: 5, 7, 11.
- 55 READ CHAPTER 15.
CH. 15 REVIEW QUESTIONS: ALL.
CH. 15 PROBLEMS: 1, 3, 5, 7, 11, 13, 15, 23, 25, 27.
- 59 READINGS CHAPTER 16: SECTIONS 5 TO 8.
CH. 16 REVIEW QUESTIONS: 5, 6, 7, 8.
CH. 16 PROBLEMS: 19, 21, 23, 25, 27.
- 62 READ CHAPTER 17.
CH. 17 REVIEW QUESTIONS: 3, 4.
CH. 17 PROBLEMS: 1, 3, 5, 7, 9, 11, 13, 15, 19, 21, 23.
- 65 READ CHAPTER 18.
CH. 18 REVIEW QUESTIONS: ALL.
CH. 18 PROBLEMS: 1, 9, 13, 15, 21, 23, 25, 27, 31.
- 70 READINGS CHAPTER 19: UP TO AND INCLUDING SECTION 8.
CH. 19 REVIEW QUESTIONS: 1, 3, 6, 9, 10, 11, 12, 13,
14, 16.
CH. 19 PROBLEMS: 1, 3, 5, 7, 9, 13, 15, 17, 23.

- NOTES:
1. FOR ABOVE SCHEDULE LECTURES ARE ASSUMED TO BE ONE HOUR LONG AND THE COURSE TO BE EIGHTY HOURS.
 2. THE BELL TEXT HAS ANSWERS TO ODD NUMBERED PROBLEMS LISTED IN THE BACK OF THE BOOK. SOME OF THE ANSWERS HAVE BEEN FOUND TO BE INCORRECT. CORRECT ANSWERS ARE LISTED BELOW (THERE MAY BE OTHER MISTAKES THAT HAVE NOT YET BEEN IDENTIFIED):

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|-------|-------------------------------------|
| 11-17 | 60 mA |
| 11-19 | 40 mA |
| 17-5 | 1.63 V |
| 17-17 | 1640 OHMS, 1.62 mW, 0.81 mW |
| 17-21 | 107.7 mA, 68.6 mA, 76.1 mA, 22.6 mA |
| 17-23 | 1.15 V, 1.04 V, 1320 OHMS |
| 19-7 | 99.5 mHz |
| 19-15 | .660 micro-F |