

SAULT COLLEGE OF APPLIED ARTS & TECHNOLOGY
SAULT STE. MARIE, ONTARIO

COURSE OUTLINE

COURSE OUTLINE: THE COMPUTER IN CONTROL SYSTEMS
CODE NO.: CET 227-5
PROGRAM: COMPUTER TECHNOLOGY
SEMESTER: THREE
DATE: DECEMBER, 1986
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NEW: X **REV.:** _____

APPROVED:

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CHAIRPERSON

DATE

CALENDAR DESCRIPTION

THE COMPUTER IN CONTROL SYSTEMS
COURSE NAME

CET 227 - 5
COURSE NUMBER

PHILOSOPHY/GOALS:

THE STUDENT WILL DEVELOP THE RELATIONSHIP BETWEEN BASIC CONTROL CONCEPTS AND THE WAY THE COMPUTER IS USED TO PROVIDE THEM. THIS WILL INVOLVE A STUDY OF THE A/D CONVERTER, D/A CONVERTER, AND THE USE OF THE COMPUTER AS A DATA ACQUISITION AND CONTROL DEVICE. THE FUNDAMENTALS OF CONTROL THEORY WILL BE STUDIED WITH INDUSTRIAL ROBOTIC SYSTEMS IN MIND.

METHOD OF ASSESSMENT (GRADING METHOD):

THE STUDENT WILL BE ASSESSED IN THE FOLLOWING MANNER:

- 1) THREE WRITTEN TESTS WORTH 20% EACH.
- 2) PROJECTS WITH INDUSTRIAL CONTROLS AND PDP 11 I/O DEVICES WORTH 20% EACH.

TEXTBOOK(S):

- 1) INDUSTRIAL ROBOTS AND ROBOTICS - E. KAPRISSEN
- M. STEPHANS
- 2) IN-PROCESS CONTROL FOR MANUFACTURING CONFERENCE
NOTES - IEEE
- 3) PDP 11 - MICROCOMPUTER INTERFACE HANDBOOK - DIGITAL
- 4) DECLAB-11/MINC USER'S GUIDE - DIGITAL (EK-MNC11-UG-002)

THE COMPUTER IN CONTROL SYSTEMS

SPECIFIC OBJECTIVES

BLOCK 1 - INTDUSTRIAL CONTROLS

1.1) CLASSICAL CONTROL THEORY

- .1) DESCRIBE WHAT CONTROL SYSTEMS ARE AND THE WAY WE USE THEM.
- .2) DEFINE THE TERMINOLOGY NECESSARY TO DESCRIBE CONTROL SYSTEMS. (ie.plant,process,system,feedback,...)
- .3) DEFINE THE DIFFERENCE BETWEEN OPEN AND CLOSED LOOP CONTROL SYSTEMS.
- .4) DISCUSS THE CONTROL SYSTEM CHARACTERISTICS. (ie.accuracy,stability,sensitivity,noise,cost)
- .5) DISCUSS THE CONTROL STRATEGY STAGES FOR MANUFACTURING PROCESSING.
- .6) ILLUSTRATE EXAMPLES OF CONTROL SYSTEMS. (ie.pessure,speed,numerical,computer,...)

1.2) MATHEMATICAL MODELING OF A CONTROL SYSTEM

- .1) DEFINE THE GENERAL EQUATION FOR A SIMPLE SERVO SYSTEM.
- .2) DRAW THE GENERAL BLOCK DIAGRAM OF A SERVO SYSTEM.
- .3) DISCUSS THE CONCEPTS OF GAIN,CASCADING BLOCKS, SUMMING JUNCTIONS AND BLOCK REDUCTION.
- .4) DISCUSS CONTROL SYSTEM TRANSFER FUNCTION AND FIRST ORDER DIFFERENTIAL EQUATIONS.
- .5) ILLUSTRATE EXAMPLES OF FIRST ORDER DIFF. CONTROL SYSTEMS: - MECHANICAL
- ELECTRICAL

1.3) INDUSTRIAL SERVO CONTROL SYSTEMS

- .1) DISCUSS THE MEANING OF A FEEDBACK CONTROL SYSTEM.
- .2) DISCUSS THE EVALUATION OF PERFORMANCE OF FEEDBACK SYSTEMS.(ie.error,setpoint,dynamic reponse,...)
- .3) DRAW A BLOCK DIAGRAM OF A CLOSED-LOOP FEEDBACK SYSTEM WITH A ROBOT IN THE SYSTEM.
- .4) DESCRIBE SIMPLE SPEED CONTROL - PROPORTIONAL
- P + INTEGRAL
- P + I + DERIVATIVE
- .5) DISCUSS A SERVOMOTOR CONTROL SYSTEM.

THE COMPUTER IN CONTROL SYSTEMS

SPECIFIC OBJECTIVES

BLOCK 1 - INDUSTRIAL CONTROLS

1.4) THE ACTUATORS OF A INDUSTRIAL CONTROLS

- .1) DESCRIBE THE ADVANTAGES & DISADVANTAGES OF THE THREE TYPES OF ACTUATORS USED IN INDUSTRY.
- .2) DESCRIBE THE FACTORS WHICH INFLUENCE THE CHOICE OF A AN ACTUATOR FOR GIVEN APPLICATION.
- .3) DISCUSS ELECTRICAL ACTUATION
 - SOLENOIDS
 - RELAYS
 - AC SERVOMOTOR
 - STEPPER MOTORS
- .4) DISCUSS HYDRAULIC ACTUATION
 - LINEAR
 - ROTORY
- .5) DISCUSS PNEUMATIC ACTUATION
 - LINEAR
 - ROTORY

1.5) INDUSTRIAL SENSORS & TRANSDUCERS

- .1) DEFINE THE MAJOR DIFFERENCE BETWEEN THE TERMS SENSOR AND TRANSDUCER.
- .2) DESCRIBE THE CATEGORIZATION OF SENSORS:
 - MECHANICAL
 - FLUID
 - THERMAL
 - OPTICAL
- .3) DISCUSS THE DIFFERENT TYPES OF MECHANICAL TRANSDUCERS:
 - DISPLACEMENT
 - STRAIN
 - MOTION
- .4) DISCUSS THE DIFFERENT TYPES OF FLUID TRANSDUCERS:
 - PRESSURE
 - FLOW
- .5) DISCUSS THE DIFFERENT TYPES OF TEMPERATURE TRANSDUCERS:
 - RTD
 - THERMOCOUPLES
 - THERMISTORS
 - IC SENSORS
- .6) DISCUSS THE DIFFERENT TYPES OF OPTICAL TRANSDUCERS:
 - OPTICAL ENCODERS
 - VISION SYSTEMS
 - CAMERAS
 - LASER SCANNERS
 - X-RAYS
 - INFRARED CAMERAS
 - 3D CAMERAS

THE COMPUTER IN CONTROL SYSTEMS

SPECIFIC OBJECTIVES

BLOCK 1 - INDUSTRIAL CONTROLS

1.6) GENERALIZED DATA ACQUISITION AND CONVERSION SYSTEMS

- .1) DISCUSS THE DATA ACQUISITION AND CONVERSION SYSTEMS USED FOR ROBOTIC TRANSDUCERS.
- .2) DISCUSS THE METHODS USED IN ANALOG-TO-DIGITAL CONVERSION.
- .3) DISCUSS THE METHODS USED IN DIGITAL-TO-ANALOG CONVERSION.
- .4) DISCUSS THE RS-232-C AND IEEE-488 BUS INTERFACE.

BLOCK 2 - COMPUTER CONTROL WITH PDP 11 COMPUTER

2.1) WORKING WITH RT-11

- .1) DESCRIBE THE RT-11 COMPONENTS:
 - HARDWARE (cpu, console, storage, I/O)
 - SOFTWARE (O/P, languages, applications)
- .2) DESCRIBE THE RT-11 OPERATING SYSTEM:
 - UTILITY PROGRAMS
 - MONITOR TYPES (SJ, FB, XM)
 - MONITOR COMPONENTS (RMON, KMON, USR)
 - DEVICE HANDLERS
 - SUPPORT FOR LANGUAGE PROCESSORS
- .3) DISCUSS THE LANGUAGE PROCESSORS:
 - ASSEMBLERS
 - COMPIERS
 - INTERPRETERS
- .4) DISCUSS THE TERMINAL OPERATIONS:
 - (KED, COPY, DELETE, SET, DATE, TIME, DIR, SQUEEZE, FORMAT)
- .5) DESCRIBE THE STORAGE DEVICE HANDLING:
 - DEVICE NAMES
 - FILE SPECIFICATIONS
 - FILE MTCE.COMMANDS
 - CREATING SYSTEM DISKS
- .6) DISCUSS THE USE OF KED EDITOR:
 - CREATING, SAVING, VIEWING, EDITING FILES
 - FUNCTION KEYS
 - INSERTING, DELETING, RESTRING TEXT
- .7) DESCRIBE THE TYPES OF PERIPHERIALS:
 - I/O DEVICES - A/D, D/A, RT-CLOCK, SCHMITT TRIGGER
 - PRINTER

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THE COMPUTER IN CONTROL SYSTEMS

SPECIFIC OBJECTIVES

BLOCK 2 - COMPUTER CONTROL WITH PDP 11 COMPUTER

2.2) PROGRAMMING WITH RT-11

- .1) DESCRIBE THE PROCEDURES FOR CREATING COMMAND FILES.
- .2) DISCUSS THE USE OF LIBRARIES IN THE RT-11 SYSTEM.
- .3) DISCUSS THE METHODS OF SERVICING I/O:
 - PROGRAMMED I/O
 - INTERRUPTS & TRAPS
- .4) DESCRIBE THE PROGRAMMING OF INTERRUPTS AND TRAPS.
- .5) DISCUSS THE USE OF INTERRUPT DRIVEN I/O DEVICES.
- .6) DESCRIBE THE DEVELOPMENT OF INTERRUPT & TRAP HANDLERS.
- .7) DISCUSS THE RT-11 I/O PROGRAMMING SYSTEM.