Exam Review

MR-1

Test Conditions

Closed Book, Closed Notes

May use 216 mm × 280 mm note sheet, *eyes only.*

Calculator allowed.

No electronic organizers, computers, or other devices ...
... that can store significant amounts of text.

Test Format and Topics

Duration, 50 minutes, this room, Wednesday 17 March 1999.

Exam starts 8:40.

One or two problems and one set of short-answer questions.

Material up to and including operating systems overview.

How to Allocate Study Time:

50% Working on conditioning problems.

25% How transducers and sensors work and OS basics.

25% Miscellaneous. (Units, parts of RTS, etc.)

MR-2

This Review:

- Overview of Real Time Systems
- Conditioning Problems
- Sensors, Transducers, and Physical Quantities
- Circuits
- OS Overview Overview

Overview of Real Time Systems

MR-3

Parts of RTS

Sensor, Actuator, Process, Computer

Know how each part fits into whole system.

Know how RT computer hardware and software ...
... are different than general purpose computer and software.

Challenges in Building a RTS

Specification, testing, evaluating reliability.

Typical Problem

MR-4

Purpose: convert a process variable value ...
... into an electrical or information quantity.

Solution to Typical Problem:

- Identify what *is given* and what output *is needed.*

  Be sure to identify **what form** output is needed in: ...
  ... voltage, current, number written in a computer memory, etc.

- Choose transducer (or use one specified) ...
  ... to convert process variable to a raw electrical quantity.

- Choose analog-to-digital converter, if necessary.

- Design conditioning circuit ...
  ... to convert raw electrical quantity ...
  ... to a form suitable for an analog-to-digital converter ...
  ... or to the form requested in the problem statement ...
  ... or to whatever form is specified in the problem.

- Design interface routine.

  Interface routine must account for:
  Transducer Response
  Conditioning Circuit Response
  Analog to Digital Conversion
  ... and ...
  The Desired Output

Each problem has its own constraints ...
... those constraints must be identified ...
... and the circuit designed accordingly.

Transducers and Sensors

MR-5

For every sensor and transducer:

- Be able to explain how it works.
- Know its strengths and weaknesses . . .
  . . . relative to other sensors measuring same physical quantity.
- Understand the units in which the process variable is measured.

If a model function was presented in class:

- Know which conditioning circuit(s) to use.

Temperature Transducers

MR-6

Temperature Definition

Know definition of thermodynamic and practical scales.

Thermistor

Know how to derive linear model from model function.

Know how to use linearization circuit (shunt resistor).

RTD

Know how to use three-wire bridge connection.

Thermocouple

Know how to use tables.

Know how to use isothermal block.

Integrated Temperature Sensor

MR-7

Light Sensors

Units

Definition of different quantities, *e.g.*, irradiance.

Radiometric v. photometric units.

Know how to convert between quantities under simple situations.

Photodiode, phototransistor.

Vacuum-tube photocell, photomultiplier.

Displacement and Proximity Sensors

Potentiometer

LVDT

Capacitive

Coded

Relative v. absolute types.

Know gray/binary conversion.

Reed Switch

Hall Effect

Magnetic Reluctance

Cross-correlation speed sensor.

MR-8

Strain, Force, and Pressure

Units

Definition of strain, force, and pressure.

Different measures of pressure.

Strain Gauge.

Derivation of gauge factor.

Use in bridge.

Force

Construction of large- and small-displacement sensors.

Pressure

Construction of large-displacement sensors.

Construction of diaphragm sensors.

Flow

Units, etc.

- Measures of flow: volumetric, mass, velocity.
- Open v. closed conduit.
- Fluid v. slurry.

Sensors

- Rotation.
- Obstruction.
- Hot-wire anemometer.
- Weir. (Water drop.)
- Cross-correlation.
- Doppler (sonar).

Chemical

Gas Sensors

- Humidity.
- Oxygen.

Fluid

Reference electrodes.

Ion concentration.

Circuits

Amplifiers

Non-Inverting Amplifier

The Versatile Inverting Amplifier

- "Plain" inverting amplifier.
- Summing amplifier.
- Gain/offset amplifier.
- Current-to-voltage converter.

Instrumentation Amplifier

Other Circuits

Wheatstone bridge.

- Know how to place complementary pairs in bridge.
- Know exact and approximate formulæ.

Operating Systems

Function: resource allocation.

Tasks

Threads

- Difference between task, program, and executable.

Task Management

Context switching.

Life of a Task.

Kernel.