CARIBBEAN MARITIME UNIVERSITY

LIBRARY GUIDE

AN EXAMINATION STUDY GUIDE

FACULTY OF ENGINEERING AND APPLIED TECHNOLOGY

Semester II 2024-2025

Exam Dates: April 12 – May 2, 2025

FINAL EXAM PREP GUIDE

FOR

CONTROL SYSTEMS ENGINEERING 1

Bachelor of Engineering in Industrial Engineering

Prepared by the Information Resources and Digital Services Librarian

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1. Key Focus Areas for Final Exams

Since your exams are **next week,** this guide prioritizes **high-yield topics, problem-solving strategies, and quick revision techniques.**

Most Important Topics (Based on Past Exams):

✓ **System Modelling** (Mechanical/Electrical systems, transfer functions)
✓ **Time Response Analysis** (1st & 2nd-order systems, transient specs)
✓ **Stability Analysis** (Routh-Hurwitz, Root Locus)
✓ **Frequency Response** (Bode Plots, Nyquist Criterion)
✓ **PID Controller Design** (Ziegler-Nichols tuning)

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2. Last-Week Study Plan

Day 1-2: Review Core Concepts & Formulas

- **Laplace Transforms** (Memorize common pairs: step, ramp, exponential).
- **Transfer Functions** (Practice converting differential equations → TF).
- **Block Diagram Reduction** (Know series, parallel, feedback rules).

Quick Exercise:

Given:

$$d^2y/dt^2+3\,dy/dt+2y=5u(t)$$

Find the transfer function Y(s)/U(s)

Day 3-4: Stability & Time Response

- **Routh-Hurwitz Criterion** (Determine stability without solving roots).
- **Root Locus Sketching Rules** (Asymptotes, breakaway points).
- **Transient Response Specs** (Rise time, %OS, settling time for 2nd-order systems).

Quick Exercise:

Check stability for characteristic equation:

$$s^3 + 4s^2 + 6s + 20 = 0$$

Day 5: Frequency Response & PID Control

- **Bode Plot Basics** (Identify gain/phase margins).
- **PID Tuning** (Proportional vs. Integral vs. Derivative effects).

Quick Exercise:

Tune a PID controller using Ziegler-Nichols (given critical gain K_{cr} and period P_{cr}.

Day 6: Solve Past Papers (3+ Years)

- CMU Library has archived exams—practice under timed conditions.
- Focus on repeated question patterns (e.g., stability analysis, TF derivation).

3. Exam Strategy

Time Management (3-Hour Exam Example):

- 5 mins: Scan all questions, start with easiest.
- 1.5 hrs: Solve high-weight problems (e.g., root locus, PID design).
- 30 mins: Review calculations (check Routh tables, Laplace transforms).

Common Mistakes to Avoid:

❌ Misapplying Routh-Hurwitz (skip a row? Recheck coefficients).

❌ Incorrectly sketching root locus (verify asymptote angles).

❌ Forgetting steady-state error calculations (use final value theorem).

4. Quick Reference Formulas

Topic	Key Formula
2nd-Order System	$T_s \approx \zeta \omega n 4$, %OS = $e^{-\zeta\pi/\sqrt{1-\zeta 2}}$
Routh-Hurwitz	First column must have no sign changes for stability.
PID Control	$u(t) = K_p e(t) + K_i \int e(t)dt + K_d de/dt$

5. Emergency Help Resources

- **Your Lecturer:** Last-minute Laplace transform help.
- **MATLAB Shortcuts:** Use tf, step, rlocus, bode commands for quick verification.
- **Librarian's Picks:**
  - Control Systems by W. Bolton
  - Modern Control Systems by Richard C. Dorg
  - **YouTube:** Brian Douglas Control Systems (https://www.youtube.com/user/ControlLectures)

6. Final Checklist Before Exam

- ✅ Re-derive **2+ transfer functions** from differential equations.
- ✅ Sketch **1 root locus** and **1 Bode plot** from memory.
- ✅ Solve **1 PID tuning problem** (Ziegler-Nichols).
- ✅ Review **2 past exam questions** (CMU Library archives).

Good luck! You've got this.