# BCS-2025 Assignment 1: the Fundamentals of Control Systems

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May 4, 2025

## 1 Introduction

The first assignment of the BCS course covers the following topic:

- fundamental concepts of control systems;
- system identification and modelling;
- transfer function and analysis of fundamental properties;
- PID controllers

The focus of this assignment is on developing the following skills:

- system analysis and modelling;
- computational problem solving skills;
- applying knowledge in realistic problems;
- presentation skills;
- teamwork.

## 2 Deliverables

Each team needs to finish 2 tasks described below and compile their solutions in a single slide-pack using Microsoft Powerpoint.

The final product of your assignment 1:

1. a single pdf file with all slides for task 1 and 2 inside.
2. a 10 minute (min 8 min, max 12 min) presentation consists of:
    - 1st part: task 1 findings;
    - 2nd part: solutions to one of the problems in task 2;
    - Q&A from the audience.

## 3 Grading

The grading of this assigment will be from a scale of 0 to 15 and will takes up 17.5% of your final grade if a student's peer-review factor is 1.0 . Details are as follows:

- $\mathcal{X} \in [0, 9]$ presentation skills for both task 1 and task 2, rubric seen appendix.
- $\mathcal{Y} \in [0, 8.5]$ solutions to the problems in task 2. The grading needs to be done in the following manner:
  - $\mathcal{A}$: *completeness of answers.* If you have submitted answers to all questions, you get 1 point otherwise 0.
  - Each question will be graded as *wrong* 0, *partially correct* 0.3, *mostly correct* 0.7, *fully correct* 1. In case of un-readable solution, the corresponding question will be graded as *wrong.*
  - A *correctness* score equals to the sum of all questions $\mathcal{B} \in [0, 10]$ is calculated.
  - $\mathcal{Y} = \lceil \mathcal{A} + 0.75\mathcal{B} \rceil$
- total score $\alpha = \mathcal{X} + \mathcal{Y}$

## 4 Task 1

In task 1, you need to:

1. Provide an overview of a real-life control system, specify the following:
   (a) Draw a block diagram
   (b) What is the input?
   (c) What is the output?
   (d) What are the uncertainties?
   (e) What is the controller?
   (f) What is the process/plant?
   (g) What is the sensor?
   (h) What might cause trouble?
   (i) Any solution you find for mitigating the trouble? If yes, briefly mention how. If no, brainstorm how you might approach this issue.

   You should not present exactly the same repetitive example appeared in the lecture or lecture notes. You may use examples in reading material or academic papers you might find as long as you give proper reference. Understand and tell in your own words, do not copy!
   *Hints:*

   - "Aim small, miss small."
     Pick one specific operational variable in the application, instead of presenting the full picture of a complex system. You have limited time so you should scope narrowly.
   - Some possible themes (not mandatory but only for inspiration):
     (a) injection moulding in factories
     (b) earthquake dampers in skyscrapers
     (c) operation of 3D printers

(d) hydraulic machines
(e) offshore wind turbines
(f) smart agriculture
(g) currency trading in the financial market
(h) flow control in tranffic planning
(i) ......

2. Answer the question:
   Can you use a PID controller in that system you present?
   Give a simple example how.

## 5 Task 2

Solve all questions in 'Stage ONE Problems' and compile your solutions . In the second part of the presentation, you need to present the solution to one randomly chosen problem. The randomly chosen problem will be pick at the beginning of the presentation session such that the student will have no chance to prepare for only one question in advance. The intention & requirement is that all students should understand your group's solutions to all problems.

The algorithm for selecting the problem to be presented:

**Algorithm 1** Problem Selection

**Input**
 $\mathcal{G} : \{g_i, i \in \mathbb{Z}\}$ the set of group numbers
 $\mathcal{R}$ random number generator
**Output**
 $\mathcal{P} : \{p_i, i \in \mathbb{Z}\}$ the set of problems to be presented for each group
$x_1 \leftarrow \mathcal{R}$
$x_2 \leftarrow \mathcal{R}$
**for** $g_i$ in $\mathcal{G}$ **do**
 $d_i \leftarrow x_1 \cdot g_i + x_2$
 $p_i \leftarrow d_i \pmod{10} + 1$
**end for**

# A Presentation Grading Rubric

| Criteria | Description | Grade |
|---|---|---|
| Content (2.5) | *The slides layout, design must be professional and consistent. No un-necessary animation and information. Graphs and images must be readable, meaningful, and relevant.* Slide contents are delightful to read and being carefully designed. | |
| Accuracy (2) | *The presentation contents should be correct* and to the point. | |
| Delivery (2.5) | *The presentation finishes around 10 mins. The presenters present clearly in voice, body language, and contents. The presentation should tell a logical story.* The presentation is smooth, fluent, and concise in story-telling. | |
| Teamwork (1) | *Every student in each team needs to be present. All group memebers show professional behavior.* Group members collaborate well in the presentation. | |
| QA Handling (1) | *The group member must ask for and respond to questions in a professional manner. The responses should make sense.* The response should be correct and to the point. The discussion needs to be fruitful. | |
| **Final Grade** | ——————————————— | |

## Grading guidelines

For each item in the rubric, 4 grade levels can be given:

- Insufficient (0%)
- Sufficient (50%)
- Good (75%)
- Excellent (100%)

The *italic* contents in the description indicates the minimum requirement for obtaining a 'Good'. If there exist further non-italic description, then these act as a guideline for being 'Excellent' in one item.

The grade obtained for each item is thus calculated by the max point for this item multiplied by the percentage corresponding to the graded level.

The final grade $\mathcal{X}$ would be the sum of grades obtained in all items.