**PROJECT TITLE**

**EEE 498 ENGINEERING DESIGN I**

**DESIGN PROJECT REPORT**

**in**

**Electrical and Electronics Engineering**

**Gaziantep University**

**Supervisor**

**Prof. Dr. Name SURNAME**

**by**

**Name SURNAME (of student 1)**

**Name SURNAME (of student 2)**

**Name SURNAME (of student 3)**

**Name SURNAME (of student 4)**

**Month Year**

The design project report entitled **PROJECT TITLE** submitted by **Name SURNAME (of student 1), Name SURNAME (of student 2), Name SURNAME (of student 3), Name SURNAME (of student 4)** for partial fulfillment of design project requirements in EEE 498 Engineering Design I course is approved by,

Prof. Dr. Name SURNAME

(Supervisor) …………..............

 Signature

# ABSTRACT

**PROJECT TITLE**

Abstract should be in English, contain only 1 paragraph, and not exceed 1 page.

**Key Words:** Keyword 1, Keyword 2, Keyword 3, Keyword 4, Keyword 5.

# ÖZET

**PROJE BAŞLIĞI**

Özet Türkçe ve tek paragraf olmalı, 1 sayfayı geçmemelidir.

**Anahtar Kelimeler:** Anahtar Kelime 1, Anahtar Kelime 2, Anahtar Kelime 3, Anahtar Kelime 4, Anahtar Kelime 5.

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We would like to thank …

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# LIST OF SYMBOLS

|  |  |
| --- | --- |
| **α** | Alfa |
| **β** | Beta |
| **Ω** | Ohm |
| **π** | Pi |

# LIST OFABBREVIATIONS

|  |  |
| --- | --- |
| **A/D** | Analog to Digital |
| **B-SPM** | Bilinear Static Parametric Model |
| **CE** | Certainty Equivalence |
| **D/A** | Digital to Analog |
| **DC** | Direct Current |
| **DIN** | Dynamic Inertial System |
| **FD** | Fault Detection |
| **FDD** | Fault Detection Diagnosis |
| **FDI** | Fault Detection and Isolation |
| **FTC** | Fault Tolerant Control |
| **g-DIN** | Generalized Dynamic Inertial System |
| **ISE** | Integral Square Error |
| **ISR** | Interrupt Service Routine |
| **LQR** | Linear Quadratic Regulator |
| **LTI** | Linear Time Invariant |
| **MIMO** | Multi Input Multi Output |
| **MRAC** | Model Reference Adaptive Control |
| **MSE** | Mean Square Error |
| **PDJ** | Positive Diagonal Jordan |
| **PEA** | Parametric Eigenstructure Assignment |
| **PSUPA** | Power Supply/Power Amplifier Unit |
| **SISO** | Single Input Single Output |
| **SPR** | Strictly Positive Real |

# CHAPTER I

# INTRODUCTION

## 1.1 Motivation of Study

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**Figure 1.1** Equivalent control system block diagram for time-varying gain control equivalent is system block diagram for time-varying gains.

There are wide varieties of control methods in FTC and an extensive research is still conducted. However the lack of a systematical approach is still an open problem. The equation sample can be given as follows:

  (1.1)

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 (1.2)

**Table 1.1** Process parameters

|  |  |
| --- | --- |
| **Parameters** | **Value** |
| Tank height, *hmax* | 25 cm |
| Pomp voltage level | 0-5 V |
| Bottom area, Tank1, Tank2, *A1*, *A2* | 0.01389 m2 |
| Bottom area, Tank3, Tank4, *A3*, *A4* | 0.01389 m2 |
| Out pipe cross-sectional area, *a1,a3,,a2,a4* | 50.26e-6 m2 |
| Pomp constant, *k* | 2.2e-3 lt/Vs |
| Tank1 operating point level *h1o* | 8.0 cm |
| Tank2 operating point level *h2o* | 5.0 cm |
| Tank3 operating point level *h3o* | 1.5 cm |

**Table 1.2** System operating point

|  |  |  |
| --- | --- | --- |
| Control Method | Output1 ISE | Output2 ISE (×103) |
| Design I | 391.59 | 1.0151 |
| Design II | 389.58 | 0.6418 |
| Design III | 379.61 | 0.0001 |

#

# REFERENCES

1. Srinivas, P., Lakshmi, K. V., Kumar, V. N. (2014). A Comparison of PID Controller Tuning Methods for Three Tank Level Process, *International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering*. **3(1)**, 6810-6820. **(Journal Sample)**
2. Iqbal, M., Bhatti, A. I., Butt, Q. R. (2008). Controller Synthesis of an Uncertain Three Tank System Using Polytypic system Approach, *Proceedings of the 17th World Congress, The International Federation of Automatic Control*. 9910-9915. **(Conference Sample)**
3. Tao, G., Chen, S. H., Tang, X. D., Joshi, S. M. (2004). *Adaptive control of systems with actuator failures*. Springer-Verlag: London. **(Book Sample)**
4. AOAC. Association of Official Analytical Chemists. (1998). AOAC peer verified methods program. Manual on policies and procedures. AOAC Intl.: www.aoac.org.tr, 17.05.2010. **(For internet citation)**.
5. Srinivas, P., Lakshmi, K. V., Kumar, V. N. (2014). A Comparison of PID Controller Tuning Methods for Three Tank Level Process, *International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering.* **3(1)**, 6810-6820. **(Journal Sample)**
6. Iqbal, M., Bhatti, A. I., Butt, Q. R. (2008). Controller Synthesis of an Uncertain Three Tank System Using Polytypic system Approach, *Proceedings of the 17th World Congress, The International Federation of Automatic Control*. 9910-9915. **(Conference Sample)**
7. Tao, G., Chen, S. H., Tang, X. D., Joshi, S. M. (2004). *Adaptive control of systems with actuator failures*. Springer-Verlag: London. **(Book Sample)**
8. Srinivas, P., Lakshmi, K. V., Kumar, V. N. (2014). A Comparison of PID Controller Tuning Methods for Three Tank Level Process, *International Journal of Advanced Research.* **3(1)**, 6810-6820. **(Journal Sample)**
9. Iqbal, M., Bhatti, A. I., Butt, Q. R. (2008). Controller Synthesis of an Uncertain Three Tank System Using Polytypic system Approach, *Proceedings of the 17th World Congress, The International Federation of Automatic Control*. 9910-9915. **(Conference Sample)**
10. Tao, G., Chen, S. H., Tang, X. D., Joshi, S. M. (2004). *Adaptive control of systems with actuator failures*. Springer-Verlag: London. **(Book Sample)**
11. AOAC. Association of Official Analytical Chemists. (1998). AOAC peer verified methods program. Manual on policies and procedures. AOAC Intl.: www.aoac.org.tr, 17.05.2010. **(For internet citation)**

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