**CMP4102 Instrumentation and Control Engineering**

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| Period per  Week | | | Contact Hour per Semester | Weighted  Total Mark | Weighted  Exam Mark | Weighted Continuous Assessment Mark | Credit  Units |
| LH | PH | TH | CH | WTM | WE | WCM | CU |

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| 45 | 30 | 00 | 60 | 100 | 60 | 40 | 4 |

**Rationale**

The computer is an electronic device whose design and manufacture utilizes a great deal of instrumentation and control engineering concepts. A student of computer engineering has to be exposed to the relevance of these fundamental concepts in the design of computer circuitry.

**Objectives**

This course aims at:

 Enabling student understand that control systems are a daily phenomena, that virtually everything needs feedback, that electronic or electromechanical systems most times include a feedback loop, either explicitly or implicitly.

 Giving the student knowledge of analog and digital control engineering concepts.

This course aims to help the student with:

 Knowledge of procedures for measuring and improving the reliability of digital components within measuring systems.

 Knowledge of the formal standards governing instrument calibration procedures and measurement system performance.

 An introduction on the topic of sensors and their use within instrumentation systems.

 Knowledge of the principles and theory of measurement

**Course Content**

***1. Review of Measurement Specification***

 Standards, units- instrument types

 performance characteristics: static and dynamic characteristic

***2. Measuring system***

***3. Analogue Instruments***

 Moving coil,

 iron instruments

***4. Digital Instruments***

 Multimeters

 data analysers

 signal synthesisers.

***5. Counters and timers***

***6. Measuring Errors***

 Random errors

 Systematic errors

***7. Transducers***

 Measurement of displacement

 velocity and acceleration

 time and frequency

 light,

 temperature, volume, pressure, flow and force

***8. Analogue Data Processing***

 The operational amplifier

 Characteristics

 Configurations

***9. Simulation of differential equations and transfer function***

***10. Data Acquisition and Conversion***

 Sampling theorem

 Quantisation

 Multiplexing

 filtering sample and hold

 Bridge Circuits

***11. Introduction to design of feedback systems***

 Properties and advantages of feedback systems

***12. Time-Domain And Frequency-Domain Performance Measures***

***13. Stability And Degree Of Stability***

***14. Complex Plane Analysis***

 Algebra

 Applications to Control Engineering

***15. Stability Criteria***

 Routh’s Criterion

 Root locus method

 Nyquist criterion

***16. Bode Plots***

 Introduction

 Frequency response analysis

***17. Unit Circle***

 PID Compensator

 time response

***18. State Space Analysis***

 Observability

 Controllability and the corresponding vectors

***19. Digital Control System***

 z transforms

 Jury Test

**Learning Outcomes**

The student will:

 Be able to comfortably check for stability of any system using any criteria.

 Understand the concept of control system engineering, why it is carried out and will appreciate its application in digital control.

 Acquire knowledge of the type of measuring instruments and be able to appreciate why certain instruments are m ore favourable in a particular environment and requirement (accuracy or precision among others);

 Understand the types of errors that occur during measurement and how best they can be minimised during experimental setup.

 Acquire concepts on sensors and their use in design of automated systems.

**Recommended Books and References**

*[1]* William L. Brogan, *Modern Control Theory,* 2nd ed., Prentice-Hall, 1985

*[2]* Nise, N. S, *Control Systems Engineering,* 3rd ed., New York, NY: Wiley, 2000.

*[3]* Allan S. Morris, *Measurement and Instrumentation Principles,* 3rd ed., Butterworth

Heinemann, 2001

*[4]* K. Ogata, *Discrete- Time Control Systems*