Course Number: **EE 402**

Course Title: Control Engineering II (Elective Course)

Course Description :

Review of stability criteria and techniques. Linear feedback system design and compensation methods. Introduction to nonlinear control systems: The describing function and phase plane analysis. Stability criteria for nonlinear systems. On-off control systems and optimum switching. Introduction to optimal control theory. Simulations.

Prerequisites :

EE380 Control Engineering I

Textbook :

Non-Linear Control Engineering, D. P. Atherton,Van Nostrand Reinhold Company, 1982

Other Useful References and Material :

- Applied Nonlinear Control, J. J. E. Slotine &W. Li, Prentice-Hall, 1991
- Nonlinear Systems Analysis, M. Vidyasagar, Prentice-Hall, 1993
- Nonlinear Systems, R. R. Mohler, Prentice Hall,1991
- Nonlinear Control Systems: Analysis and Design, H. J. Marquez, Wiley, 2003
- Modern Control System 11^{th} edition, R. Dorf, R. Bishop, Pearson, 2011

Website :
http://www.kfupm.edu.sa/ee/bscourses.htm
Course material will be also available in electronic format on WebCT

Course Objectives :

- Students will apply knowledge gained in basic mathematics, physical sciences and engineering courses to derive mathematical models of typical engineering processes.
- They will learn the role of a control engineer in multi-disciplinary teams (Criterion 3(d)).
- The course will show how to characterize modeling uncertainty, and formulate and solve basic robust and nonlinear controller design problems (Criterion 3 (c),(e)).
- The course will provide an introductory treatment of advanced analysis and synthesis methods for nonlinear systems, emphasizing also the use of computer-aided design tools (Criterion 3(k)).

Topics Covered :

- Linear Feedback System Design and Compensation
- Introduction to Nonlinear Control Systems

- The Describing Function Analysis of Nonlinear Systems and Limit Cycles
- The Phase Plane Analysis
- Classification of Singular Points & The Phase Portrait
- Existence and Stability of Limit Cycles
- Poincare & Bendixon Theorems
- Fundamentals of Lyapunov Theory and the Concepts of Stability
- Positive Definite Functions and the Lyapunov Function
- Methods for Generating the Lyapunov Function
- Introduction to Optimal Control Theory
- Nonlinear Control System Design: Sliding Mode and Adaptive Control

Class/Laboratory Schedule :.

3 lectures per week, 50 minutes each and 3 hours lab per week.

Course Outcomes :

- Acquire working knowledge of system science-related mathematics
- Design a system, component or process to meet desired needs
- Identify, formulate and solve control engineering problems
- Use the techniques, skills and modern control engineering tools necessary for engineering practice

Prepared by