Course code	Course Name	L-T-P -Credits	Year of Introduction
EE467	Nonlinear Control Systems	3-0-0-3	2016

Prerequisite: Nil

Course Objectives:

- To introduce the need and concept of nonlinear system.
- To impart knowledge about different strategies adopted in the analysis of nonlinear systems.
- To familiarize with the design of different types of nonlinear controllers.

Syllabus:

Characteristics of nonlinear systems- equilibrium points-phase plane analysis-periodic orbits-stability of nonlinear systems-Lyapunov stability-variable gradient method-centre manifold theorem-circle criterion-Popov criterion-Feedback linearization-Exact Feedback linearization.

Expected outcome

The students will be able to

i. design controllers for nonlinear systems.
ii. analyse the stability of nonlinear systems using various approaches.

Text Books:

1. Alberto Isidori, "*Nonlinear Control Systems: An Introduction*", Springer-Verlag, 1985
2. Hassan K Khalil, Nonlinear Systems, Prentice - Hall International (UK), 2002.
3. Jean-Jacques E. Slotine and Weiping Li, "*Applied Nonlinear Control*", Prentice-Hall, NJ, 1991.

References:

1. M. Vidyasagar, "*Nonlinear Systems Analysis*", Prentice-Hall, India, 1991,
2. Shankar Sastry, "*Nonlinear System Analysis, Stability and Control*", Springer, 1999.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Introduction - Characteristics of nonlinear systems - Classification of equilibrium points- analysis of systems with piecewise constant inputs using phase plane analysis.	7	15%
II	Periodic orbits - limit cycles-Poincare-Bendixson criterion-Bendixson criterion. Existence and uniqueness of solutions, Lipschitz condition.	7	15%
	FIRST INTERNAL EXAMINATION		
III	Stability of Nonlinear Systems - Lyapunov stability - local stability - local linearization and stability in the small- Direct method of Lyapunov - generation of Lyapunov function for linear and nonlinear systems – variable gradient method.	7	15%
IV	Centre manifold theorem - region of attraction - Feedback Control and Feedback Stabilisation-Analysis of feedback systems- Circle Criterion – Popov Criterion.	7	15%
	SECOND INTERNAL EXAMINATION		

V	Feedback linearization- Design via linearization- stabilization - regulation via integral control- gain scheduling.	7	20%
VI	Exact Feedback Linearization - Input state linearization - input output linearization - state feedback control - stabilization - tracking - integral control.	7	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN:

Maximum Marks: 100 Exam Duration: 3Hourrs.

Part A: 8 compulsory questions.

One question from each module of Modules I - IV; and two each from Module V & VI.

Student has to answer all questions. (8 x5)=40

Part B: 3 questions uniformly covering Modules I & II. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Part C: 3 questions uniformly covering Modules III & IV. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Part D: 3 questions uniformly covering Modules V & VI. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.