Course Title: Nonlinear Systems
Course Code: EE651A
Instructor: Dr Abhilash Patel (apatel@iitk.ac.in)
Teaching Assistants: Kushal Pratap Singh (kushalp20@iitk.ac.in), Arijit Bhowmik (arijitb21@iitk.ac.in)
Course webpage: https://home.iitk.ac.in/~apatel/teaching.html
Lectures Time: MWF, 9.00AM-10AM
Lectures Venue: ACES 213
Office Hour: on email request

Contents:

Topics
- Nonlinearity in the system
- Nonlinearity induced dynamical behaviors
- Existence and Uniqueness
- Sensitivity to Parameter and Initial Conditions
- Local Linearization: Perturbation
- Local Linearization: Describing Function
- Global Linearization: Feedback
- Global Linearization: Carleman
- Phase-plane Analysis and Nullclines
- Poincare Map
- Poincare-Bendixson Theorem and higher versions
- Bifurcations
- Different notions of stability and significance
- Lyapunov theory and applications for stability
- Invariance theorem, Barbalat's lemma
- Contraction theory and Incremental Stability
- Convergent Dynamics
- Passivity-based analysis
- Periodic systems and Lyapunov exponents
- Multistability
- Scale-invariance

Grading Policy:
Mid Sem Exam- 20%
End Sem Exam- 30%
Course Project/Term Paper- 30%
Assignments and Quizzes- 20%

Recommended Textbooks:
1. Shankar Sastry, Nonlinear Systems, Springer, First Edition
2. Hasan Khalil, Nonlinear Systems, Prentice Hall, Third Edition
3. Steven Strogatz, Nonlinear Dynamics and Chaos: With Applications To Physics, Biology, Chemistry, And Engineering, Westview Press, First Edition
4. Mathukumalli Vidyasagar, Nonlinear Systems Analysis, SIAM, Second Edition
5. Alberto Isidori, Nonlinear Control Systems, Springer Verlag, Third Edition