

**DEPARTMENT OF INSTRUMENTATION & CONTROL ENGINEERING
NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI**

Course Title	Nonlinear Control Systems			
Course Code	ICPE 23	Credits	3	
Department	ICE	Faculty	Dr. Ramakalyan Ayyagari	
Pre-requisites	ICPC 21, ICPC 24			
Other Course Teacher(s)/Tutor(s)	--	Mobile No.	9443923485	
		Email	rkalyn@nitt.edu	
Course Type	Program Elective, July 2018 Session			
COURSE OVERVIEW				
This course is a rigorous extension of the basic signals, systems, and control courses where nonlinearities are emphasized. The course is largely set in a mathematical framework and applications, e.g. robotics, are studied in the last two units of the course.				
COURSE OBJECTIVES				
Upon completing this course, the student would be competent enough to understand the analysis and design of nonlinear control systems with application in Robotics, Aerospace, and the like.				
COURSE OUTCOMES (CO)				
1.	In unit I, core mathematical ideas will be reinforced with a bent on nonlinear functions.			
2.	In unit II, students will be exposed to the classical 1 st and 2 nd order systems.			
3.	In unit III, an in-depth exposure to nonlinear dynamics, and robotic applications is provided.			
4.	In unit IV, students are taken up to higher levels of control design to feedback linearization.			
5.	In unit V, other nonlinear control strategies are briefly explored with several case studies.			
Alignment with the Program Outcomes: 1,5,6,9,10 & 12				
COURSE TEACHING AND LEARNING ACTIVITIES				
Classes	Dates	Topic(s)	Delivery	
1	July 11	Introduction to the course	Board	
2 – 9	July 17, 18, 24, 25, 31	Review of Linear Control Theory, Introduction to Nonlinearities	Board/PPT	
10 – 18	Aug 1, 7, 8, 21, 28, 29	Classical Nonlinear Control – graphical techniques, describing functions etc.	Board/PPT	
19 – 24	Sep 18, 19, 25, 26	Nonlinear Dynamics – Newtonian, Lagrangian, & Hamiltonian, Chaos, Bifurcations etc.	Board/PPT	
25 – 31	Oct 3, 9, 10, 16, 17	Control of a class of nonlinear systems – Feedback Linearization	Board/PPT	
32 – 37	Oct 23, 24, 30, 31	Other approaches to control of nonlinear systems, Case studies	Board/PPT	
Classes will be held on Tuesdays 10.30 am to 12.10 pm & Wednesdays 10.30 am to 11.20 am				
COURSE ASSESSMENT METHODS				
S.No.	Mode of Assessment	Date	Duration	Weightage
1.	Assessment – 1 (written)	August 7	60 minutes	20%
2.	Assessment – 2 (written)	Sept 26	60 minutes	20%
3.	Assessment – 3/ MiniProject	Submission before October 25		20%
4.	Assessment – 4	Nov 1	180 minutes	40%
5.	Compensation Assessment	Nov 8	120 minutes	20%
6.	Re-Assessment	Nov 15	180 minutes	100%
RESULTS WILL BE SUBMITTED TO THE PAC AS PER SCHEDULE				

ESSENTIAL READINGS:

1. Solitine, J-J.E., & Li, W., Applied Nonlinear Control, Prentice Hall, 1991
2. Khalil, H.K., Nonlinear Systems, 3/e, Pearson, 2014
3. Spong, M.W., Hutchinson, S., Vidyasagar, M., Robot Modeling & Control, Wiley, 2006
4. Strogatz, S.H., Nonlinear Dynamics and Chaos: with Applications to Physics, Biology, Chemistry, and Engineering, 2/e, Westview Press (USA), Basic Books (India) 2014
5. Brogan, W.L., Modern Control Theory, Prentice Hall
6. Meiss, J.D., Differential Dynamical Systems, SIAM, 2007
7. Campbell, S.L., & Haberman, R., Introduction to Differential Equations with Dynamical Systems, Princeton Univ. Press, 2008
8. Marino, R., & Tomei, P., Nonlinear Control Design: Geometric, Adaptive & Robust, Prentice Hall, 1995

COURSE EXIT SURVEY

Feedback from the students during the class committee meetings

Feedback after Mid-term examination for mid-course correction

Feedback before End-term examination through a questionnaire, for improvements in future.

COURSE POLICY (including plagiarism, academic honesty, attendance, etc.)

- At least 75% attendance during the class-work is mandatory. Up to 10% shall be allowed under on-duty (OD category). Students with less than 65% attendance will be prevented from writing the final examination and shall be awarded "V" grade.
- No compensation assessment if the instructor is not convinced with the reasons/proofs provided for the student's absence in Assessments 1, or 2, or 3.
- Grading would be relative, with class-average, or 60% whichever is higher, taken as the benchmark – average and above shall get S, A, and B grades, and below average shall get C, D, E, and F.

Academic Honesty:

- All the Assessments in this course must be strictly individual work.
- However, collaboration by individuals is encouraged at the level of ideas.
 - Feel free to ask each other questions, or brainstorm on solutions, or work together on a board. However, be careful about copying the actual solution. This sort of collaboration at the level of artifacts is permitted if explicitly acknowledged, but this is usually self-defeating.
- The principle behind the collaboration rule is simple:
 - I want you to learn as much as possible; you may learn from me or from each other.
 - The goal of artifacts is simply to demonstrate what you have learned. So, I'm happy to have you share ideas, but if you want your own points you have to internalize the ideas and then craft them into an artifact by yourself, without any direct assistance from anyone else, and without relying on any idea taken from others.

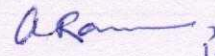
Academic Dishonesty: For purposes of this class, academic dishonesty is defined as:


- Any attempt to pass off work on a test that didn't come straight out of your own head.
- Any collaboration on artifacts in which the collaborating parties do not clearly explain exactly who did what, at turn-in time.
- Any activity that has the effect of significantly impairing the ability of another student to learn.
- Other clauses laid out by the O/o the Dean Academic and the Department of ICE, including possession of mobile phones, shall also attract disciplinary action and appropriate penalty.

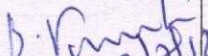
ADDITIONAL COURSE INFORMATION

All the students are urged to be interactive during the classes. Further, the students are suggested to make a google group for faster dissemination of PPTs, discussions on projects etc. They are free to interact with me over email any time, and if needed meet me in person with prior appointment.

FOR SENATE'S CONSIDERATION


Course Faculty 11/7/18
Dr. Ramakalyan Ayyagari


CC-Chairpersons 12/07/2018
Mrs. V. Sridevi


HOD 12/27/18
Dr. B. Vasuki