Indian Institute of Technology, Kanpur
Proposal for New Course
Department of Aerospace Engineering

Course Title: System Identification Techniques for Aerial Vehicles

Course Number:

Credits: 3-0-0-0 [9]

Pre-requisite: AE647A or equivalent

Who can take the course: Masters and Ph.D. Students

Proposer & Instructor: Dr. Subrahmanyam Saderla
Interested Second Instructor: Dr. Raghavendra P Kukillaya

Course Objective: The objective of the course is to familiarize students with existing system identification techniques applied to flight vehicles. The focus will be on the applicability of various estimation techniques in different flight conditions and the quality of sensor data. This course will be beneficial for comprehensive analysis of flight vehicle's performance, stability, and control.

	Course Content	**Lecture hours**
1.	Introduction to system identification and its applications to flight vehicles	2
2.	Mathematical modelling for nonlinear aircraft dynamics	5
3.	Aircraft Simulation model with numerical integration techniques, linear and nonlinear aerodynamic models, flight envelope bifurcation	2
4.	Data Gathering from flight testing, Instrumentation, and optimal input design	3
5.	Filtering and compatibility analysis of flight data	3
6.	Cost functions, Gauss-Newton optimization, and automatic gradient computation with step-size control	5
7.	Equation error method, Weighted Least Squares, and Recursive Least Squares estimation for flight vehicle	6
8.	Output error method for aerodynamic characterization of aircraft	6
9.	Filter error method for linear and nonlinear systems	6
10.	Proof-of-match exercise	2
	Total Lecture Hours	**40**

References:

- Nelson, Robert C. Flight Stability and Automatic Control, Vol. 2, WCB/McGraw Hill-1998
- Pamadi, Bandu N. Performance, Stability, Dynamics, and Control of Airplanes AIAA-2004
- Kimberlin, Ralph D. Flight Testing of Fixed-Wing Aircraft, AIAA-2003
- Goodwin, Graham C. Dynamic System Identification: Experiment Design and Data Analysis-1977
- Mehra, Raman. Optimal Inputs for Linear System Identification, IEEE Transactions-1974
- Draper, Norman R.   Applied Regression Analysis, Vol. 326, John Wiley & Sons-1998
- Myers, Raymond H.   Classical and Modern Regression with Applications, Vol. 2, Duxbury Press-1990
- Rossi, Richard J. Mathematical Statistics: An Introduction to Likelihood-Based Inference, John Wiley & Sons-2018
- Jategaonkar, Ravindra V. Flight Vehicle System Identification: A Time Domain Methodology, Vol. 216, AIAA Series-2006
- Simon, Dan. Optimal State Estimation: Kalman, H∞, and Nonlinear Approaches, John Wiley & Sons-2006
- Haykin, Simon. Kalman Filtering and Neural Networks, Vol. 47, John Wiley & Sons-2004

Dated: 20-03-2024
Proposer: SUBRAHMANYAM SADERLA

Dated:
DPGC Convener:

This course is approved/not approved.
Chairperson, SPGC.
Dated: