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

AE 651

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:

PGDesk-IITK-DOAA

From: spgc@iitk.ac.in
Sent: 10 July 2024 13:31
To: DPGC, AE
Cc: pgdesk@iitk.ac.in
Subject: Re: Regarding new course proposal

@ Raviji - Please do the needful if everything is in order.

> Dear Sir,
>
> We did not receive any comments for below these three course proposals.
> Kindly do the needful for further approval.
>
> https://www.iitk.ac.in/doaa/data/NewCourses/Course-proposal-AEXXX-MDO.pdf
>
> https://www.iitk.ac.in/doaa/data/NewCourses/Course-proposal-AE6XX-Structural-Vibration-and-Control.pdf
>
> https://www.iitk.ac.in/doaa/data/NewCourses/Course-proposal-AEXXX-System-Identification-Techniques-for-Aerial-Vehicles.pdf
>
> Regards,
> Convener, DPGC
> Aerospace Engineering
> IIT Kanpur
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>

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Best,
Abheejeet Mohapatra
Chairperson SPGC

AE

O/C scan 27/8/24

INDIAN INSTITUTE OF TECHNOLOGY KANPUR
POSTGRADUATE OFFICE

No. A(P)/IITK/course approval/
August 27, 2024

The Convener, DPGC
Departments of AE/SEE/CHE/SPASE
IIT Kanpur

I am directed to communicate the concurrence of the SPGC (2023-24) in its 10th meeting held on 15/07/2024 for the approval of new PG course proposal. After detailed discussion the following courses were approved.

Course No	Title	Credits	Instructor	SPGC Decision
SPA626	Space Environments and Space Systems	3-0-0-0-(9)	Dr. Rohit Sharma Dr. Soumyabrata Chakrabarty	Approved
AE631	Multidisciplinary Design Optimization	2-0-3-0-(9)	Dr. Prabhat Hajela, Dr. Pradeep Moise	Approved
AE632	Structural Vibration and Control	(3-0-0-0-9)	Dr Tanmay Mathur Dr Dipak Giri	Approved
AE651	System Identification Techniques for Aerial Vehicles	3-0-0-0-(9)	Dr. Subrahmanyam Saderla	Approved
SEE618	Heating, Ventilation, and Air-conditioning of Buildings	3-0-0-0-(9)	Dr. Aakash Chand Rai	Approved
CHE669	"Chemical Kinetics: Reaction Rate Theories and Rare-Event Simulations	3-0-0-0-(9)	Dr. Vishal Agarwal	Approved

Assistant Registrar
Academic Affairs

C: OARS (DOAA Office) For necessary action