Course Number : AR513
Course Name : Unmanned Aerial Systems (UAS)
Credit Distribution : 3-0-0-3
Intended for : UG, PG and PhD
Prerequisite : Consent of faculty advisor
Mutual Exclusion : None

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1. Preamble:

Students will be introduced to agile micro aerial vehicles that are able to operate autonomously in cluttered indoor and outdoor environments. They will gain an introduction to the mechanics of flight and the design of quadrotor flying robots and will be able to develop dynamic models, derive controllers, and synthesize planners for operating in three dimensional environments. The students will be exposed to the challenges of using noisy sensors for localization and maneuvering in complex, three-dimensional environments. Finally, the course will provide insights through seeing real world examples of the possible applications and challenges for the rapidly-growing drone industry.

2. Course Modules with quantitative lecture hours:

Introduction: Historical background of UAS, Current trends in UAS, Introduction to Unmanned Aerial Robotics (UAVs) and quadrotors. **(5 hours)**

Geometry and Mechanics: Frame Rotations, Representations and Coordinate Systems, Kinematics and dynamics of system model, Derivation of Aerodynamic Forces. **(6 hours)**

Perception and State Estimation: Sensors on-board, Inertial sensing, Concepts of Kalman Filtering, Inertial Navigation System design. **(8 hours)**

Flight Control: Planar and three-dimensional dynamic models, Linear controllers for these models, Proportional Integral Derivative control, Linear Quadratic Regulator control, Linear Model Predictive Control. **(8 hours)**

Path Planning: Collision-free Navigation, Structural Inspection Path Planning, Target Follow, Coordinated Motion, Collaborative Aerial Manipulation, Autonomous Exploration. **(7 hours)**

Final project: Student project towards simulation and design of UAS. **(8 hours)**

3. Textbooks:

1. Paul Gerin Fahlstrom, Thomas James Gleason, "Introduction to UAV Systems", Wiley.
2. Reg Austin, "Unmanned Aircraft Systems: UAVS Design, Development and Deployment", Wiley. 3.
3. R. Kurt Barnhart, Douglas M. Marshall, Eric Shappee, "Introduction to Unmanned Aircraft Systems", CRC Press.

4. References:

1. Kenzo Nonami et. al., "Autonomous Flying Robots: Unmanned Aerial Vehicles and Micro Aerial Vehicles", Springer.
2. Kimon P. Valavanis, George J. Vachtsevanos, "Handbook of Unmanned Aerial Vehicles", Springer.

5. Similarity with the existing courses:

(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.		Course Code	Similarity	Approx. % of Content

			Content	
1.		None	None	None

6. Justification of new course proposal if cumulative similarity content is >30%: None