Course Number : AR515
Course Name : Sensors and State Estimation
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:

This course provides an overall exposure to sensing technology. The course covers a wide range of related topics. The objective of this course is to impart knowledge on smart sensing technology and its applications. By the end of the course, the student will be able to-

- Select right sensor(s) for a particular application
- Understand the importance of data fusion and state estimation
- Estimate the state of the system of interest using sensor fusion

2. Course Modules with quantitative lecture hours:

Sensors: Introduction and motivation, different types of sensors and their real time applications, signal conditioning, classic vs smart sensors. **(10 hours)**

Recursive State Estimation: Overview, basic concept in probability, robot environment interaction, Bayes filter. **(7 hours)**

Filtering Techniques: Introduction, Kalman Filter (KF), Extended Kalman Filter (EKF), Unscented Kalman Filter (UKF), Particle Filter, and Quantum Stochastic Filtering. **(15 hours)**

Multi-sensor Data Fusion: Introduction to multi-sensor systems, some examples like Unmanned Aircraft System (UAS), reference frame for multi-sensor fusion, calibration, synchronization, multi-sensor fusion with EKF. Case study and course projects. **(10 hours)**

3. Textbooks:

1. Thrun, Sebastian. "Probabilistic robotics" Communications of the ACM 45.3 (2002): 52-57.
2. Fraden, Jacob. "Handbook of modern sensors: physics, designs, and applications" (1998): 357-359.

4. References:

1. Bhuyan, Manabendra. Intelligent Instrumentation: Principles and Applications. CRC Press, 2010.
2. Sawhney, A. K. "Electrical and electronic Measurements and Instrumentation" (1985).
3. Behera, Laxmidhar, and Indrani Kar. "Quantum stochastic filtering" 2005 IEEE International Conference on Systems, Man and Cybernetics. Vol. 3. IEEE, 2005.
4. Meijer, Gerard, ed. Smart sensor systems. John Wiley & Sons, 2008.
5. Jacob Fraden, “Handbook of modern Sensors”, AIP Press, Woodbury (1997).
6. E. O. Deobelin and D. Manik, “Measurement Systems – Application and Design”, Tata McGraw-Hill (2004).
7. Yallup, Kevin, and Krzysztof Iniewski, eds. Technologies for smart sensors and sensor fusion. CRC Press, 2014.
8. Prosser, Stephen J., and Ernest DD Schmidt. "Smart sensors for industrial applications." Sensor Review (1997).

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 Content	Approx. % of Content
1.		None	None	None

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