7ᵗʰ Semester	RAE7D006	Aircraft Navigation Systems	L-T-P 3-0-0	3 Credits

Module-I: **(6 hours)**

NAVIGATION SYSTEMS& SENSORS
Introduction to aircraft navigation systems– Introduction to Inertial Sensors - Mechanical - Ring Laser gyro- Accelerometers, Fiber optic gyro – MEMS system, Multi-sensors navigation.

Module-II: **(8hours)**
INERTIAL NAVIGATION SYSTEMS
INS components: transfer function and errors- Earth in inertial space - coriolis effect – INS Mechanization. Platform and Strap down – Navigation algorithms - INS system block diagram, Different co-ordinate systems – Transformation Techniques - Schuler Tuning - compensation errors - Gimbal lock - Initial calibration and Alignment Algorithms.

Module-III: **(8 hours)**

NAVIGATION, TRACKING AND SAFETY SYSTEMS
Different types of radio navigation- ADF, VOR, DME - Doppler – Hyperbolic Navigations -LORAN, DECCA and Omega – TACAN, ILS, MLS, GLS - Ground controlled approach system - surveillance systems-radio altimeter, TCAS, ATC transponder, Automatic dependent surveillance,Regional Navigation Systems- Distress and Safety- ospas-Sarsat- Inmarsat Distress System- Location-Based service,Emergency locator transmitters.

Module-IV: **(8 hours)**

MISSILEAND UAV NAVIGATION
Tactical Guidance Intercept Techniques, Proportional Navigation, Augmented and 3D Proportional Navigation, Optimal Control of Linear Feedback system, Way-point Navigation, UAV Control Stations, Path Planning,CollisionAvoidanceand Mid-air Collision (MAC) Avoidance.

Module-V: **(8 hours)**

SATELLITE NAVIGATION & HYBRID NAVIGATION
Introduction to Global Navigation Satellite Systems, Concepts of GPS, DGPS, Introduction to Kalman filtering-Estimation and mixed mode navigation Integration of GPS and INS-utilization of navigation systems in aircraft.

Books:
[1]   Mike Tooley, David Wyatt"Aircraft Communications and Navigation Systems", 2nd edition,Routledge, 2018.
[2]   Myron Kyton, Walfred Fried, 'Avionics Navigation Systems', John Wiley & Sons,2nd edition, 1997
[3]   Global Navigation Satellite Systems, Inertial Navigation, and Integration, 3rd EditionMohinder S. Grewal, Angus P. Andrews, Chris G. Bartone
[4]   Nagaraja, N.S. ―Elements of Electronic Navigation, Tata McGraw-Hill Pub. Co., New Delhi, 2ⁿᵈ edition, 1975
[5]   Reg Austin, Unmanned Aircraft Systems: UAVS Design, Development and Deployment, wiley, 2010.
Digital Learning Resources:

Course Name:	IISc, Bangalore
Course Link:	http://nptel.ac.in/courses/101108056/
Course Instructor:	Dr. D. Ghose