# RESEARCH AND TRAINING UNIT FOR NAVIGATIONAL ELECTRONICS
# OSMANIA UNIVERSITY – HYDERABAD

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| **5-Day School on (GNSS-25-1)**<br>**DEVELOPMENT OF GNSS RECEIVERS: SOFTWARE AND HARDWARE** | **Course Code : NERTU/SC/87**<br>**09-13, SEPTEMBER 2025** |
| **5-Day School on (GNSS-25-2)**<br>**INTEGRATION OF GNSS, INS AND OTHER AUXILIARY SENSORS** | **Course Code : NERTU/SC/88**<br>**16-20, SEPTEMBER 2025** |

**Introduction:** It is the era of development and movement towards autonomous navigation for indoor and outdoor applications, covering global and local regions. Autonomous navigation is required for land, sea, and air vehicles, for travelling from one point to another, for search and rescue operations, surveying, surveillance, agriculture, mining, tracking objects in crowds, functions, meetings, etc. All these applications with autonomy require local, temporal, and environmental information like obstacles, path changes, placement of objects, etc., and absolute positioning is required to reach the destination or location in the global space. Local and temporal information about the neighborhood area of interest is available from optical, LIDAR, laser, and radar sensors. But, for many applications, to go to the designated areas of search and rescue operations, surveillance, mining, and to come back home, autonomous vehicles require the absolute position. GNSS is the cheapest solution for absolute positioning.

## About 5-Day School on Development of GNSS Receivers: Software and Hardware

Though many people are using GPS or GNSS for navigation and other applications, very few people are working to develop the GNSS receivers and simulators in India. Development of GNSS receivers requires the expertise in Signal Processing, Communication and navigation algorithms. There will be high demand for indigenous GNSS receivers with compatibility to process the signals of NavIC and other constellations. Similarly, there will be high demand for Hybrid navigation systems with high accuracy, availability, continuity, integrity for autonomous vehicles and other applications. Almost all the Hybrid navigation systems will include a GNSS receiver and therefore the knowledge of design and development of GNSS receivers is essential for development of Autonomous Navigation systems.

The school is designed for the engineers, scientists, academicians and research scholars, already working or decided to work in the development of GNSS receivers, navigation systems and their applications. This school will cover tentatively the following lectures and demos by experts working in this field. Review of GNSS Signals, Receiver Overview, Antennas, RF Front ends, Acquisition, Tracking, Navigation Data Decoding, Computation of Pseudoranges and Pseudorange Rates and Navigation Solution, RAIM and TRAIM. Multipath Effects and Interference, Jamming and Spoofing, Code and Carrier Phase Measurements, Advanced Tracking Algorithms: Vector Tracking Loops, Fast Acquisition with External Aiding, Tracking Loops for High Dynamics and Spinning Projectiles.

## About 5-Day School on Integration of GNSS, INS and other auxiliary sensors

GNSS devices will help us to get the absolute position, but it is vulnerable to jamming, spoofing, effects of multipath, interference and blockage of signals. An Inertial Navigation System (INS) is self-contained and gives the relative position with respect to the initial position. It is not affected by jamming, spoofing, or other external environmental conditions. But INS requires the initial position and alignment. The accuracy of the independent INS degrades with time considerably due to its accumulating errors. So, for long-term navigation, the INS requires external aiding. Hence, GNSS/INS integration is suggested to improve the accuracy, availability, continuity, and integrity of the navigation services. Indigenously developed Integrated NavIC and INS navigation systems are hardly available for public in India. When the GNSS signals are not available, other sensors like magnetometer, barometer and odometer will help us to improve the accuracy. So, in this school, the basic concepts of GNSS, INS, barometer, magnetometer and their integration algorithms will be covered.

The school is designed for the engineers, scientists, academicians and research scholars, interested to develop the integrated navigation for the challenging environment and for autonomous vehicles. This school will cover tentatively the following lectures and demos by experts working in this field. Basics of Inertial Navigation Systems, Inertial Sensors, Coordinate Systems, Euler Angles and Quaternions, INS Mechanization, Basics of Kalman Filter, Noise parameters and specifications of IMU sensors, Extended Kalman Filter for INS, Integrated Navigation System with GNSS and INS, Loosely Coupled Integration, Tightly Coupled Integration, Ultra Tightly Coupled Integration, INS Initialization, Magnetometer, Barometer, Transfer Alignment.

**Venue:** NERTU Auditorium, OU (Online only for exceptional cases) **Time:** 09.00AM – 06.00PM

**Last Date for Registration: 25th August 2025**

**More details like Speakers, topics, final schedule and accommodation will be available after 31st July 2025 and visit https://nertu.osmania.ac.in/ for updates and registration.**

**COORDINATORS, GNSS-25:** **Prof. P. LAXMINARAYANA,** Director, NERTU, OU, Ph: 949 080 5486, laxminarayana@osmania.ac.in
**Mrs. S. SARASWATHI,** NERTU, OU, Ph: 994 899 1235, sirikondasaraswathi@osmania.ac.in

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**About NERTU:** The Research and Training Unit for Navigational Electronics (NERTU) is established in 1982. It is the focal point for research and training in the areas of Electronic Navigation in India. It is the first University Research Center to work in Global Positioning System (GPS) and GPS Aided Geo Augmented Navigation (GAGAN) System. Since its inception, NERTU has successfully **executed 65 sponsored and consultancy projects; and 85 short term courses, conferences and workshops in the areas of** signal processing, communications and navigation. All the sponsored projects and participants of the courses are from various organizations like DRDO labs, ISRO labs, DST, MIT, ECIL, HAL, BEL, AICTE, ASL, other R&D and academic institutions. Recently NERTU has developed the Real Time NavIC Software Receiver running on PC; and loosely and tightly coupled integration of GNSS/NavIC and MEMS IMU and ready to develop the commercial products through Transfer of Technology to industries. At present working on development of GNSS simulators and Ultra tightly Coupled Integration of GNSS/NavIC and MEMS IMUs.

**Venue : NERTU Auditorium, OU**
(Can Join In-Person or Online)

**Time : 09.00AM – 06.00PM**

**Last Date for Registration: 25th August 2025**

**Limited Accommodation is available on Payment at University Guest House**

**More details like Speakers, topics, final schedule and accommodation will be available after 31st July 2025 and visit https://nertu.osmania.ac.in/ for updates and link to registration form**

**Please contact for any queries**

**COORDINATORS, GNSS-25- 1 & 2**

1. **Prof. P. LAXMINARAYANA,** Director, NERTU, OU, Ph: 949 080 5486, laxminarayana@osmania.ac.in
2. **Mrs. S. SARASWATHI,** NERTU, OU, Ph: 994 899 1235, sirikondasaraswathi@osmania.ac.in

| Registration Fee (including GST 18%) , 5% extra after 25th August 2025. (encouraging in-Person only) | 5-Day School (any one) | | Both Schools | |
|---|---|---|---|---|
| | In Person | Online (per participant) | In Person | Online (per participant) |
| Students (Full Time) | 5000 (5900) | 8000 (9440) | 9000 (10620) | 15000 (17700) |
| Faculty /Acdemicans | 10000 (11800) | 15000 (17700) | 18000 (21240) | 30000 (35400) |
| Scientists & Engineers from R&D, Industry | 20000 (23600) | 30000 (35400) | 35000 (41300) | 60000 (70800) |

**DD/Cheque should be drawn in favor of "The Director, NERTU, OU"**

**or**

**Online payment through NEFT to "The Director, Eqpt. Maint., NERTU, OU",**

**Within India: A/C No. : 52198270713, IFSC: SBIN0020071, Osmania University Branch, State Bank of India**

**Through UPI ID: 52198270713@sbin0020071.ifsc.npci**

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