

**Course Contents:**

Overview of GNSS and Introduction to GPS, GLONASS, GALILEO, COMPASS, IRNSS systems; GPS: Basic concepts, signal structure and code modulation Pseudo-range measurements and navigation position; Errors and biases in GPS measurements, Accuracy of navigation position: UERE and DOP. Intentional degradation of GPS signals: Selective availability (SA) and Anti-spoofing (AS), Differential GPS: Space based augmentation systems (e.g., SBAS, GAGAN) and Ground based augmentation systems (e.g., WASS, EGNOS); GPS Carrier Phase measurements: Signal Differencing, Double Differencing and Triple Differencing in GPS measurements. Ambiguity resolution, multi path and other observational errors, Doppler effect on GPS signals, Code and Phase combinations for Ionosphere free, Geometry free, Multipath reduction, Ambiguity resolution, Code smoothing, Cycle slip detection and repair; GPS data processing, sequential solutions, Kalman filtering and adjustment computation for GPS; Surveying with GNSS: Point positioning, Relative positioning, Static and Kinematic positioning; Planning and field observations, Networking, Data Post processing, GIS and GPS integration; GNSS applications to Earth Systems, IGS and IERS services.