## Course Plan

## AH2923 – VT 2019 Global Navigation Satellite Systems (GNSS)

| Date | Time | Course | Room | Topic | Reading |
|---|---|---|---|---|---|
| Mon 18/3 | 10:00-12:00 | Lecture 1 | L31 | Course introduction, introduction to GPS/GNSS, basic principle for positioning, selected applications | GNSS: p. 1-12 + 309-340 |
| Thu 21/3 | 10:00-12:00 | Lecture 2 | Bora Bora | Reference systems, reference ellipsoid, N, E, U, azimuth and elevation angle, time systems | GNSS: p. 13-25 + 277-302 |
| | 13:00-16:00 | Lab 1 | M102 | Implement geodetic tools: (lat, lon, height) <-> (X, Y, Z), (X, Y, Z) <-> (N, E, U), azimuth, elevation angle and distance | Lab 1 and Lab 2 reports due: 31/3 |
| Mon 25/3 | 10:00-12:00 | Lecture 3 | L31 | Satellite orbits, Kepler elements, perturbations, broadcast ephemeris, precise orbits | GNSS: 27-53 |
| | 13:00-16:00 | Lab 2 | M102 | Compute satellite position from broadcast ephemerids | Lab 1 and Lab 2 reports due: 31/3 |
| Thu 28/3 | 10:00-12:00 | Lecture 4 | Bora Bora | GNSS signals, code and carrier phase, signal propagation, ionosphere, troposphere | GNSS: p.55-68 + 105-140 |
| Mon 1/4 | 10:00-12:00 | Lecture 5 | L31 | Multipath, other error sources, error budget and mitigations, observation equations | GNSS: p.141-160 |
| | 13:00-16:00 | Lab 3 | M102 | Implement atmospheric models | Lab 3 report due: 14/4 |
| Thu 4/4 | 10:00-12:00 | Lecture 6 | L31 | Absolute positioning, least squares adjustment, DOP | GNSS: p. 161-165 + 238-241 + 250-257 + 262-276 |
| | 13:00-16:00 | Lab 4 | M102 | Compute receiver position from pseudoranges | Lab 4 report due: 21/4 |
| Mon 8/4 | 10:00-12:00 | Lecture 7 | L31 | Relative positioning, carrier phase based positioning, ambiguity resolution, cycle slip detection and correction | GNSS: p. 173-183 + 193-237 |
| Thu 11/4 | 10:00-12:00 | Lecture 8 | Bora Bora | Static and kinematic positioning, RTK, planning Applications | GNSS: p. 183-191 + 460-466 |
| | 13:00-16:00 | Lab 5-A | --- | Group 1: GNSS observations (static and RTK) - NB this is outside | No report, but obligatory |

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| Thu 25/4 | 10:00-12:00 | Lecture 9 | L44 | DGPS, WADGPS, Kalman filtering and smoothing | GNSS: p. 169-173 + 241-250 |
| | 13:00-16:00 | Lab 5-B | --- | Group 2: GNSS observations (static and RTK) - NB this is outside | No report, but obligatory |
| Thu 2/5 | 10:00-12:00 | Lecture 10 | Bora Bora | GLONASS, Galileo, Beidou, regional systems<br>GNSS future development | GNSS: p. 341-430 |
| | 13:00-16:00 | Lab 6 | M102 | Compute receiver position from code and phase data | Lab 6 report due: 12/5 |
| Thu 9/5 | 13:00-16:00 | Lab 7 | M102 | Compute ambiguity resolution | Lab 7 report due: 19/5 |
| Mon 13/5 | 10:00-12:00 | Lecture 11 | L44 | GNSS data processing. Discussion of journal papers, sustainability and ethical aspects of GNSS. M.Sc. project ideas, discussion before exam | Journal papers |
| | 13:00-16:00 | Lab 8 | M102 | Compute GNSS positions with data from Lab 5 | Lab8 report due: 26/5 |
| Thu 16/5 | 10:00-12:00 | Lecture 12 | Bora Bora | Reserved time for Q&A | |
| Mon 27/5 | 14:00-18:00 | Exam | V21 | Good Luck! | |

**Reading references:**

GNSS – Global Navigation Satellite Systems by Hofmann-Wellenhof, Lichtenegger, and Wasle. Springer Verlag 2008.

**Passing the course:**

- To pass the course the student must pass the written examination (TEN; 4.5c) and be approved on all labs (LAB; 3c)
- Participation in field measurements, Lab 5, on April 11th or 25th is obligatory.

**Grades:**

Students who have completed all lab reports in due time (ref. to the due dates in the table above) achieve a bonus of 10% of points at the examination. The bonus will not be applied in a re-examination.

Written exam: Monday, May 27th, 2019 @ 14:00 – 18:00 in room V21.