LIST OF EXAMINATION ISSUES FOR the SECOND-CYCLE STUDIES IN THE FIELD OF GEODESY AND CARTOGRAPHY, SPECIALIZATION MOBILE MAPPING AND NAVIGATION SYSTEMS

General issues in the field of geodesy and cartography

1. Cadastral systems with example of Polish cadastral system (idea, content of databases, data exchanging between main components).
2. ISO 19100 series standards – the role in using geographic data.
3. Isostatic models of Earth's crust and internal structure of Earth.
4. Concepts of precision, accuracy and uncertainty of measurement and discussion under their practical aspects for surveying.
5. Dimensioning of objects applied in metrology versus control measurements known in surveying engineering.
6. Modern measuring technologies in engineering and industrial surveying: possible applications.
7. Assessment of the height accuracy for elevation models (DTM, DSM) developed with ALS data.
8. Orthorectification of the aerial photo: list of initial data and estimation the location accuracy of a digital orthophotomap.
9. Data source and approaches in 3D city modeling – description current state, assessment of 3D models and trends in buildings modelling and models application.
10. Gravimetric anomalies – computation and use for geodetic and geophysical purposes.
11. Gravimetric geoid computation method by RCR technique.
12. Modern height definition by the geopotential number.
13. Coordinate system on the two-axis ellipsoid: geodetic frame, ortho-cartesian frame, local north-oriented frame, astronomical frame and its relationship
14. Geodetic parameters of point localisation on kinematic frames (ITRF) and transformation to static frames (e.g., ETRF).

Specific issues related to specialization of Mobile Mapping and Navigation Systems

15. Object-oriented programming (OOP) – a brief description of the principles, idea of a class and an object, differences between procedural programming and OOP.
16. Function interpolation and approximation – description of the process and methods used. Approximating a function with the Least Squares Method.
17. Low-pass and high-pass filters - types and applications in the image for geomatics purposes.
18. The principles of feature detection and identification of characteristic elements in the image.
19. Image segmentation - characteristics in terms of the features used and selected approaches.
20. Fundamentals of computer vision - i.e. internal orientation, relative orientation, epipolar geometry, stereo computation.
21. Algorithms and methods used in an automatic Structure-from-Motion approach to image orientation.
22. Automated point cloud processing - from regularization and filtering to 3D model generation.
23. Imaging from Unmanned Aerial Vehicles (UAV) and manned aircraft – comparison assessment of current state and trends in the development of low-altitude and large-format photogrammetry.
24. Airborne laser scanning data processing: orientation methods and steps, point cloud filtration and classification, generation of digital elevation models.
25. Integration of measurement and georeference sensors in mobile measurement platforms: benefits and limitations.
26. Application of datasets from mobile mapping systems: airborne and ground-based.
27. Evaluation of sensor measurement capabilities and specification of products generated from mobile mapping systems.
28. IMU concepts – body frame angles determination with accelerometer readings and utilisation of the magnetic data.
29. Principle of GNSS positioning (principles of position determination, code and carrier-phase pseudorange measurements, code pseudorange equation, sources of errors).
30. Absolute and relative GNSS measurement techniques: SPS, static, RTK, Network RTK (features, accuracy, applications).
31. The principle of operation of the inertial sensors (based on MEMS technology), characterization of observable parameters and data fusion between inertial sensors.

32. GNSS/INS Mechanization Equation - brief description and the main purpose.
33. GNSS/INS integration systems (loose/tight/ultra-tight) - the advantages and disadvantages.
34. Receiver Autonomous Integrity Monitoring (RAIM) algorithm, the principle of operation and its applications.
35. Discrete autoregressive processes, theoretical models and applications for analysis of empirical time series.
36. Linear dynamical systems, state-space formulation, Kalman filter design and its application for sequential data processing. Main steps of Kalman filtering and the role of the Kalman Gain matrix.
37. Popular techniques of position calculation indoors and spatial data models in indoor navigation.
38. Examples of indoor navigation systems and their key requirements.
39. Indoor versus outdoor navigation - the main differences in map design and positioning methods. Alternative methods of positioning.
40. IT architecture of mobile navigation and location systems.
41. Cartographic aspects of designing navigation and location applications.
42. Algorithms of route calculation and their popular optimizations.
43. Characteristics of map-matching algorithms.
44. Principals of simultaneous localization and mapping (SLAM).
45. Weighted linear combination (WLC) - goals, assumptions and application examples.
46. Components and application of the network analysis model – possible network attributes and additional objects.
47. The architecture of big data solutions including distributed (NoSQL) databases and distributed data processing - brief description.
48. Data preprocessing for spatial big data solutions and spatial data enrichment methods. Rough sets and reduces in spatial big data.
49. The impact of autonomous vehicles on sustainable development and urban transformations of cities including trends in the development of public transport.
50. Geospatial data in augmented reality – example of applications.