1. Course title: MOBILE SYSTEMS NAVIGATION
2. Course code


4. Level of studies: MA,MSc programme

5. Mode of studies: intramural studies

6. Field of study: AUTOMATIC CONTROL AND ROBOTICS (FACULTY SYMBOL) RAU

7. Profile of studies: General

8. Programme: Robotics

9. Semester: 2, 3

10. Faculty teaching the course: Institute of Automation, Rau1

11. Course instructor: Prof. Ph.D. DSc. Aleksander Nawrat

12. Course classification: programme course

13. Course status: compulsory

14. Language of instruction: English

15. Pre-requisite qualifications: Robotics basics, Optimization methods, Automation basics, Object-oriented programming

16. Course objectives: Aim of the course is to present and explain navigation basics used in mobile systems. During lectures multiple issues associated with positioning and spatial orientation of unmanned vehicles will be presented. Additionally various methods of synthesis and integration of data from sensors for autonomous control will be explained.

17. Description of learning outcomes:

<table>
<thead>
<tr>
<th>Nr</th>
<th>Learning outcomes description</th>
<th>Method of assessment</th>
<th>Teaching methods</th>
<th>Learning outcomes reference code</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Student knows basic terms in mobile navigation (counted and observed position, course, bearing)</td>
<td>CL, PS</td>
<td>WT, WM</td>
<td>K_W2/2; W8/1</td>
</tr>
<tr>
<td>2.</td>
<td>Student knows wireless communication methods (geostationary and non-geostationary satellite systems, Dispatcher systems, trunking systems. Wireless, civil-band connectivity. Laser systems, infrared and ultrasound. Bluetooth and IrDA standards)</td>
<td>CL, PS</td>
<td>WT, WM</td>
<td>K_W4/2; W9/2; W20/2</td>
</tr>
<tr>
<td>3.</td>
<td>Knowledge about programming tools for mobile devices</td>
<td>CL, PS</td>
<td>WT, WM</td>
<td>K_W3/3; W15/1</td>
</tr>
<tr>
<td>4.</td>
<td>Knowledge about standards of security in WLAN</td>
<td>CL, PS</td>
<td>WT, WM</td>
<td>K_W4/2; W22/2</td>
</tr>
<tr>
<td>5.</td>
<td>Student is capable of implementation a program for mobile devices</td>
<td>CL</td>
<td>L</td>
<td>K_U23/3</td>
</tr>
<tr>
<td>6.</td>
<td>Student is capable of using GPS and communicate using wireless transmission</td>
<td>CL</td>
<td>L</td>
<td>K_U23/3</td>
</tr>
<tr>
<td>7.</td>
<td>Knowledge about acquisition and visualization of vector based planar data</td>
<td>CL, PS</td>
<td>L</td>
<td>K_U12/2; K_U23/3; K_U09/2;</td>
</tr>
<tr>
<td>8.</td>
<td>Student is capable of mobile devices programming environments configuration</td>
<td>CL, PS</td>
<td>L</td>
<td>K_K04/2; K05/2</td>
</tr>
<tr>
<td>9.</td>
<td>Ability to suggest and design functionalities of the software. Ability to prioritize tasks for himself and others</td>
<td>CL, PS, OS</td>
<td>L</td>
<td>K_K03/3</td>
</tr>
<tr>
<td>10.</td>
<td>Ability to cooperate in a team regardless the role in it</td>
<td>CL, PS, OS</td>
<td>L</td>
<td>K_K03/3</td>
</tr>
</tbody>
</table>
## 18. Teaching modes and hours

| Lecture | 30 / BA/MA | Seminar | Class | Project | Laboratory | 30 |

## 19. Syllabus description:

### Semester:

Lectures:

1. Computer control system – mobile unmanned vehicles control system (Introduction)
2. Introduction – the current role of the mobile systems (Explanation of the mobile processing. Presentation of the field evolution and the main impact factors. Presentation of various applications, enormous benefits for the end client and complicated and non-trivial scientific problems that needs to be solved)
3. Concepts and definitions. (Basic architectures, terminal classifications, distinction between mobile systems and wireless systems. Presentation of features network centric mobile systems)
4. Positioning of mobile users (Basic navigation concepts, units of measurement. Various ways of determining counted and observed position. Positioning devices and systems)
5. Mobile users navigation (Navigation in buildings, integrated navigation systems. Local character of positioning information. Strategies of position updating)
7. Measurement data integration (advanced filtration methods and GPS systems integration. Inertial and GPS coupled and uncoupled integration)
8. Cell systems (Main idea and reason for cell systems. Basic concepts and terms. How to increase the capacity of cell systems. Description of roaming and handover phenomenon’s. Advantages and disadvantages of cell systems)
9. GSM system architecture and terms of operation (Basic components of GSM system, architecture and types of cell terminals, base stations, central station. How to hold the information about optimal terminal position and how to establish a connection. Security issues in GSM, wireless transmission technologies used in GSM)
11. Advanced problem of mobile processing (recursive planar decomposition, planar data distribution, optimal path selection, future position prediction, uncertainty positions)
12. Wireless LAN networks (Benefits from using wireless LAN networks, architectures overview, integrated solutions, Standards 802.11/ab/g and 802.16. Media access in WLAN, types of networks devices and antennas. Security and applications of WLAN)
13. WAP Technology. WML Language (Creation of WAP websites. Basics of WML Language. Useful tools for WAP overview)
15. Military and civilian aviation applications of mobile systems (Modern applications of mobile systems. Network-centric systems. Future programs using mobile technologies like DEEPWATER, LAND WARRIOR. Unmanned Aerial Vehicles (UAV), sea and ground unmanned vehicles.

Laboratories:

1. Familiarization of the Microsoft Visual Studio 2008 for mobile applications
2. Familiarization of ways of data storage in mobile devices
3. Implementation of an example application for Pocket PC
4. Familiarization of designing mobile applications using J2ME
5. Implementation of an example application using J2ME
6. Implementation of library for importing data from MIF, SHP files
7. Implementation of module for GPS NMEA-0183 data parsing
8. Design and implementation of mobile application displaying current user position, list of available satellites and their coordinates in almanac
9. Implementation of module for planar vector data import and previsualization processing
10. Implementation of application for planar vector data visualization

11-15) Implementation of control algorithms for physical objects

## 20. Examination:

No
21. Primary sources:

22. Secondary sources:

23. Total workload required to achieve learning outcomes

<table>
<thead>
<tr>
<th>Lp.</th>
<th>Teaching mode</th>
<th>Contact hours / Student workload hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Lecture</td>
<td>30/0</td>
</tr>
<tr>
<td>2</td>
<td>Classes</td>
<td>0/0</td>
</tr>
<tr>
<td>3</td>
<td>Laboratory</td>
<td>30/60</td>
</tr>
<tr>
<td>4</td>
<td>Project</td>
<td>0/0</td>
</tr>
<tr>
<td>5</td>
<td>BA/MA Seminar</td>
<td>0/0</td>
</tr>
<tr>
<td>6</td>
<td>Other</td>
<td>0/0</td>
</tr>
<tr>
<td></td>
<td>Total number of hours</td>
<td>60/60</td>
</tr>
</tbody>
</table>

24. Total hours: 120

25. Number of ECTS credits: 4

26. Number of ECTS credits allocated for contact hours: 2

27. Number of ECTS credits allocated for in-practice hours (laboratory classes, projects): 3

26. Comments:

Approved:

(date, Instructor’s signature)   (date, the Director of the Faculty Unit signature)