FUNDAMENTALS OF SATELLITE NAVIGATION
DISTANCE LEARNING COURSE
PRESENTATION CONTENTS

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1. Introduction

- A full-fledged course «all-in-one»: theoretical material, tests, practical trainings, control question
- Interactive mode: possibility of video addition, external source attribution, possibility of user interaction
- Accessibility 24/365
- Distribution of authority system
- Possibility of user operation trace
- Lecturer’s possibility to give students marks, and comment answers
- Easy-to-use navigation
- Chores automation
2. The course goal

*Course goal*

professional development of specialists of the global navigation satellite system creation and use sphere

*Target group :

- Fundamentals of satellite navigation
  - The leaders of federation subjects, municipal, federal, municipal and other administrative structures;
  - Specialists, who started work with satellite navigation systems
Objectives of the course

- Studying of GNSS creation history;
- Principals of GNSS construction and structure.

- Knowledge of mathematic basis and methods of navigation task solution;
- Study of signals, information message and link protocol used in different GNSS;

- Acquisition skills of work with navigation receiver with accuracy real-time ranking including differential system using;

- Knowledge of control methods and means of navigation sphere integrity;
- Knowledge of concrete systems GLONASS, GPS, GALILEO.
Students will get necessary stock of knowledge for working in such spheres as

- Construction
- Geodesy and cartography
- Personal navigation
- Transport
- Fundamentals of satellite navigation
- Engineering structure monitoring
3. Academic and methodological support

- requirements for the trainees' level of attainment;
- requirements for discipline mastering level;
- list of lecture topics;
- discipline program;
- theoretical material — summary of lectures;
- glossary;
- illustrations (figures, tables, diagrams, schemes and etc.);
- list of self-test questions;
- list of detailed answers to self-test questions;
- list of test question to control learning;
- list of detailed answers to them;
- list of main and complementary literature;
- instructor's manual and advices for lecturer;
- methodological instructions and advices for original research;
## List of lecture topics (72 hours). 1/2

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<tr>
<th>Topic</th>
<th>Overview</th>
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<tr>
<td>Topic 1</td>
<td>• GNSS creation and development history (4 hours)</td>
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<tr>
<td>Topic 2</td>
<td>• Principals of GNSS construction and structure (6 hours)</td>
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<td>Topic 3</td>
<td>• Mathematic basis and methods of navigation task solution (10 hours)</td>
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<td>Topic 4</td>
<td>• Study of signals, information message and link protocol used in different GNSS. (6 hours)</td>
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<td>Topic 5</td>
<td>• Navigation receivers (signal processing) (10 hours)</td>
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### List of lecture topics (72 hours). 2/2

<table>
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<tr>
<th>Topic 6</th>
<th>• Differential systems (14 hours)</th>
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<td>Topic 7</td>
<td>• Global navigational satellite system pathology monitoring. Continuity testing. (10 hours)</td>
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<td>Topic 8</td>
<td>• Coordinate temporary supply of GNSS functioning and source of navigation temporary determination errors (6 hours)</td>
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<td>Topic 9</td>
<td>• User equipment (4 hours)</td>
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<tr>
<td>Topic 10</td>
<td>• Work-in-progress GNSS (Galileo, Compass/Beidou, IRNSS, QZSS) (2 hours)</td>
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4. Peculiarities of distance learning

- It’s interactive
- Possibility of user interaction
- Possibility of self-testing and training for passing exams
- Unique laboratory work
How does it work?

After authorization student has access:

- To the materials of the course
- To the final test for self-testing
- To the control questions for passing exams
- To the laboratory works
- To lecturer's tutorials
Theoretical material

- All necessary information
- Division of the course into topics
- Simple and clear structure
- Multimedia content availability (both internal and external: YouTube, etc.)
Control Questions

- Answers to questions are given in the form of essay
- Possibility to change student’s attempts number
- Lecturer can comment student’s answers

Final Test

- Using different types of questions («Choice of several versions», «type of questions: Is the next statement right?»)
- Possibility to change student’s attempts number
How does it work?

Student studies materials of the topic and after it passes final test

Answer correctness checks automatically. Results display right after passing the test and are accessible in his personal card

When student has passed the test successfully, he answers control questions

Answers are given in the form of essay

Answers correctness is estimated by the lecturer. The lecturer gives students marks

Student can get detailed commentary on his answers (for example, reference to theoretical material)

When student has passed control questions, he starts practical trainings and laboratory works
5. Practical trainings and laboratory works

List of methodological support:

- Theoretical material
- Student’s workbook for remote access mode practical trainings which uses computerized distance learning system, including: work object, task, execution phase order, variants
- List of main and complementary literature
- Administrator guide for install and support of practical trainings
- Source code and program manual, scripts, modules nonaffiliated into proprietary or free software, which are necessary for base academic and methodological support functioning
**List of practical trainings and laboratory works**

| Training 1 | • NSS orbital structure modeling, NSS movement modeling |
| Training 2 | • User location identification on basis of distance measurements |
| Training 3 | • Autonomous data integrity control in the receiver |
| Training 4 | • Geometric extent analysis |
| Training 5 | • GLONASS navigation |
| Training 6 | • Differential navigation |
| Training 7 | • Multipath propagation analysis |
| Training 8 | • Work with GLONASS/ GPS navigational receiver |
How does it work?

Student works with real equipment or its simulation, using knowledge got on previous stage of study.

After student has finished the work, he draws up a report with graphic material.

Lecturer estimates work realization and gives marks.

Lecturer can comment upon work or send for reexecution.
An example of practical trainings realization

Getting task and studying theoretical material

Calculation realization

Analysis of results and report preparation
Practical trainings

- Real-time mode full-fledged works
- Work with real equipment
- User doesn’t need any subsidiary applications install
- Regular interaction of students and lecturer on all stages of studying
6. Conclusion

- Academic and methodological support consisting of professional subsidiary educational programs of selected training and meeting demands of educational standards is developing.
- Necessary support of training organization implying personal student accounting, add-in professional educational programs electronic versions and academic and methodological package creation, progress inspection, financial monitoring and reports preparation is developing.
- Computerized distance learning system methodological support and software formalizing educational courses electronic version presentation is developing.
- Additional theoretical material and practical training claims which take into account distance education specificity are identified.
Thank you for your attention!