Attachment 4

Syllabus

Name of training course/module	Solar collectors and panels, their installation and operation
Training course code	
An author/authors of Syllabus (lcturer, lecturers, course implementers)	Omar Zivzivadze, Professor, Akaki Tsereteli State University 0-(431)-24-23-64, 577348953, omar.zivzivadze@atsu.edu.ge Monday consultation - ATSU, VII Building, Room N324 , from 2 p.m.
Faculty, department	ATSU, Faculty of Technical Engineering, Deparftmeht of Energy and Telecommunications
Education program	IV step (Professional training)
semester	**I**
Training course status	Elective (minor)
Language of tuition	Georgian
Number of ECTS credits: *distribution of hours in accordance with student's workload*	**Credit**; (number of ECTS credits - 2,5 credits) Total hours 62.5, including: • contact hours 33 - - including: lecture - 10 hours. laboratory - 20 hours - interim and final examinations --3 hours; • independent work hours - 29,5
The goal of training course	• general guidance on the use of solar systems • familiarizing with operating principles and maintenance of solar collectors and panels • studying the installation requirements of solar collectors and panels and developing practical skills • studying the solar collectors and panels operation, monitoring and eliminating the problems
Training course format	Lecture, laboratory.
Learning outcomes, list of competences (general and industry-specific)	**Skill of practical application of knowledge** X – ability to use in practice the various-type electrical measuring instruments. – understanding of the structure and operating principles of electrical facilities – ability to connect and assemble the component parts of solar system – ability to provide elimination of the simple problems in solar systems
Teaching/learning methods	Teaching methods are: lecture, laboratory, Learning methods are: classroom work – attendance of lectures and laboratories;

<table>
<tr><td></td><td>preparation of lecture materials and home works; working in library and exam prep</td></tr>
<tr><td>Student's knowledge evaluation system and criteria</td><td>
Student's final evaluation is being carried out by adding up the scores of midterm and final exam evaluations obtained during the semester. Training course maximum evaluation scores – 100 points. The right to pass the final exam is given to student, whose minimum competence of midterm exam evaluation is not less than 18 points (of 60), and who makes 51 points at least with account of final exam maximum score. Student with evaluation less than 15 points, regardless his/her achievements in other evaluation components, should be evaluated as FX (not passed).
The grading system allows for making:
five types of evaluation:
(A) Excellent – 91 – 100 points of maximum evaluation score;
(B) Very good – 81 – 90 points of maximum evaluation score
(C) Good – 71 – 80;
(D) Satisfactory –61-70 points of maximum evaluation score
(E) Acceptable –51-60 points of maximum evaluation score
two types of negative evaluation:
(FX) Not passed –41-50 points of maximum evaluation score that means that student needs to work more, and is allowed to retake exam once by working independently.
(F) Failed to pass – 40 and less points of maximum evaluation score that means that student's work performed is not enough, and he/she has to study the discipline anew.
In case of obtaining FX evaluation in a training component of education program, the additional exam will be fixed no earlier than 5 calendar days from announcement of the examination results. The number of points made by a student in final evaluation will not be added to the additional exam evaluation points. The additiuonal exam evaluation is a final evaluation, and it will be expressed in a final evaluation of a training component of education program. In case of getting 0-50 points, a student's work is evaluated as F-0.
Midterm writing is carried once in the semester, and it covers materials of 1-7 weeks, and it is carried out after the 7th week. The final exam is taken after the 15th week.

<table>
<tr><td>Evaluation components</td><td>Component's percentage</td></tr>
<tr><td>Student's practical/laboratory work and activity</td><td>30</td></tr>
<tr><td>Midterm exam</td><td>30</td></tr>
<tr><td>Final exam</td><td>40</td></tr>
<tr><td>Total</td><td>100</td></tr>
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Evaluation rubric

1. Midterm exam implies evaluation of knowledge of the topics covered in the 1-7 weeks. Student has 1 hour for the 30-quastion task performance – evaluation for each correct answer is 1, but for the wrong answer – 0.
2. The final exam is held in written form and is of 40 points. It implies the
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	evaluation of knowledge of the topics examined within the training course. For task performance - student is given a 40-question assignment. Evaluation for each correct answer is 1, but for the wrong answer – 0. Evaluation of student's practical/laboratory work is 30 points. 3. Execution of student's laboratory work and activity. Maximum evaluation for each laboratory work is 3 points. The total number of laboratory works – 10.. **0 point** – student has not performed the work. **1 point** – student has performed the work partially and responds to the questions satisfactory. **2 points** - student has performed the practical/laboratory work partially, responds to the appropriate questions satisfactory, and describes the performed work with some inaccuracies. **3 points** - student has performed the laboratory work, described the performed work properly, and responds to the appropriate questions correctly.
Mandatory literature	1. M. Grdzelishvili, O. Giorgobiani. Heating with non-traditional renewable energy. Technical University, Tbilisi, 2012. 2. T. Museliani, G. Dolaberidze. Introduction to electrical engineering. Technical University, Tbilisi. 2008

Course content

	Teaching method	Topic	– ours	– Literature
1	Lecture	The use of solar energy for generation of thermal and electric power. The active and passive systems.	1	1,2
	Laboratory	The review of the schematic diagrams of solar systems used in heat engineering	2	
2	Lecture	The types of solar collectors, the principal device, installation notes.	1	1
	Laboratory	Installation notes of the solar collector's flat-plate and vacuum-pipe collectors	2	
3	Lecture	The types of solar panels, the principal device, installation and operation	1	1
	Laboratory	The types of solar panels, methods of their assembly and installation	2	1
4	Lecture	The types of solar panels, methods of their assembly and installation	1	1
	Laboratory	Familiarization with a set of solar energy panels (which include: solar panels, battery (12 V, 180 A), controller, inverter, 12V DC to 220 V DC converter), and feature to make solar panels assembling	2	

5	Lecture	Organizing the control of the operation of solar collectors and panels	1	1,2
	Laboratory	Establishment of working order and fault criteria of solar systems. Studying the fault correction methods.	2	
6	Lecture	Methods of simplified repairs of solar collectors	1	1
	Laboratory	The main causes of the systems failures and studying the methods and ways of their removal	2	
7	Lecture	Methods of simplified repairs of solar collectors	1	1
	Laboratory	Studying the practice of replacing the damaged components methods of re-launching the systems	2	
8	Lecture	*Additional elements of solar systems and their selection criteria*	*1*	*1*
	Laboratory	Heat transmitters. Principles of their operation.	2	
9	Lecture	Heat pump and principles of its operation. Heat pump power factor.	1	1,2,
	Laboratory	Heat pump operating modes. Air-to-water heat pumps.	2	
10	Lecture	Solar cooling systems and principles of their operation.	1	1,2,
	Laboratory	Solar cooling systems and principles of their operation	2	
	Final exam			

An author of Syllabus: O. Zivzivadze