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**Curriculum**

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| **Program** | **Engineering Technologies and Systems** |
| **Degree awarded** | **Doctor of Engineering - 04** |
| **Faculty** | **Faculty of Technical Engineering**  |
| **Program and area (concentration) coordinators** | **Professor Omar Kikvidze-Program Coordinator****Concentrations:** 1. **Material Science and Quality Control:** Coordinator – Professor Amiran Khvadagiani
2. **Civil Engineering:**  Coordinator – Professor Parmen Kipiani
3. **Power Industry Technology and Management:** Coordinator – Professor Omar Zivzivadze
4. **Mathematical Modeling of Engineering Processes and Systems:**  Coordinator – Professor Omar Kikvidze
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| **Length of the program (semester, ECTS)** | Length of the program not less than 3 years, including 45 credits - course component: Educational component includes:* General courses and seminars (30 credits)
* Concentration elective courses (15 credits)
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| **Language of the Program**  | **Georgian** |
| **Program development and renewal date of issue** | **Decision of the Accreditation Board №160 09.07.2019** |
| **Program prerequisites** |
| Program prerequisites are:* Master’s degree or the equivalent academic degree in Engineering, with the Program’s concentration-relevant qualification.
* Passing the University’s specialty exam.
* knowledge of a Foreign language (English ) at B2 level (it is necessary to pass exam at ATSU or submit appropriate certificate).

Concrete conditions of the admition exam in specialty are establihed by the ATSU’s Academic Council by Resolution No1 of 5 September 2007 “On basic principles of conducting Doctoral studies at Akaki Tsereteli State University”. <http://www.atsu.edu.ge>)In exceptional cases, if the applicant has experience in practical and/or research work (as evidenced by the documents, relevant papers or otherwise), on the basis of cross-sectoral topics of research and orders of the head of educational program, determination of the compatibility of the applicant's program admission prerequisites is a prerogative of the Faculty’s Dissertation Council, which is recorded in the relevant protocol. Admission exams are conducted in written form in foreign languages and in the relevant specialty. In case of the competition and equal scores, there will be taken into consideration: evaluation of the applicant’s Master's thesis, published papers and participation in scientific conferences. |
| **Goal of the Program** |
| The program aims to train highly qualified field specialists, who are expected to be able to identify and resolve problems existing in the field of engineering, design and analyze the new calculating models, determine and optimize the parameters of the engineering-technological processes and technical systems, as well as to conduct educational and research activities, taking into account scientific and technical achievements, based on scientific research.  |
| **Learning outcomes (the map of competences - see attached document 2)** |
| **Knowledge and understanding** | The graduate is expected to have:* knowledge of modern methods and techniques of research;
* knowledge of modern methods of teaching;
* knowledge based on the latest achievements through the analysis of information available in scientific literature and their research works;
* knowledge of modern methods of research project design and management.

The graduate is expected to understand:* the importance of research investigations for creating the modern engineering systems and developing technological processes;
* the importance of a numerical analysis for studying the engineering systems and technological processes
* the importance of knowledge acquired in general and elective courses for research activities.
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| **Applying knowledge** | The graduate is expected to be able:* to use modern methods and techniques of research ~~plan research~~ in their activities;
* to widely use the fundamental laws of mechanics and electronics in research works and solving the engineering problems;
* to develop the theoretical and physical models of different technological processes and technical systems;
* to use modern computer technologies and programs;
* to take part in creating and introducing new products;
* to analyze and control the quality of products in the fields of mechanical engineering and construction;
* to make decisions in the appropriate field with a view to energy and resource conservation;
* to work out practical recommendations based on the results of research;
* to evaluate the reliability of engineering systems in real operational conditions;
* to determine the parameters of engineering systems and technological processes on the basis of mathematical modeling;
* to provide the numerical calculations of building constructions on strength and sustainability at vibration thermodynamic loads.
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| **Making judgement** | The graduate is expected to be able:* to draw the research-based conclusions on the reliability of engineering systems and basic parameters of technological processes;
* to draw a conclusion on the relevance of research project;
* to draw a conclusion on energy-efficiency of building constructions;
* to assess the state of technological equipment;
* to analyze emergencies creating during the operation of technological equipment;
* to select ways to resolve arising problems;
* to study the damages to the structural components and to draw a conclusion on the reliability on the basis of mathematical modeling in operating conditions.
 |
| **Communication skills** | The graduate is expected to be able:* to reflect the results of research in the reports, papers, scientific publications and public discussions (including in foreign language);
* to engage actively in the discussion on the basis of knowledge relied on the latest achievements in the field;
* to engage actively in the theoretical of applied discussions, enriching and transferring the existing knowledge (including in foreign language).
 |
| **Learning skills** | The graduate is expected to be able:* to grow professionally independently by teaching skills and solving the complex problems;
* to use the modern achievements of science and technology in research investigations.
 |
| **Values** | * self-improvement and self-realization skills, professional ethics, for plagiarism and unfounded conclusions are unacceptable
 |
| **Teaching methods** |
| While achieving learning outcomes, modern techniques of interactive teaching are used and those basic activities that are included in the Doctoral Program curriculum. Particularly, transfer of theoretical material, discussion, case study, presentation, brainstorming and teamwork (collaborative teaching), **Training courses** are studied on theoretical lessons as well as by independent work of Doctoral student (on the basis of using the recommended basic manuals, supplementary literature, as well as the Internet resources). The purpose of theoretical lessons is to review the basic topics under the educational program and provide Doctoral student with relevant information. The lecture courses are aimed at theoretical study of branch and studying the essential facts accumulated in the mentioned field.**Seminar classes** envisages a thorough elaboration of the matter under consideration and preparation of presentation. For the seminar presentations, there are selected problematic issues, elaboration of which requires conceptualizing of acquired knowledge during lectures, review and analysis of the indicated literature and other sources of information, and identifying own position with regard to the matter. During seminar classes, it is necessary to assess the adequacy of perception of the selected topic and/or independently prepared material by Doctoral student. Participants in the seminar include the leading teachers engaged in the educational programs, scientific advisors of the dissertation papers, and Doctoral students. The seminar paper of Doctoral student cannot be a part of Doctoral thesis. Other conditions are established in compliance with the regulations of the Faculty’s Academic Council. Some kind of monitoring over execution of Doctoral thesis is carried out during the **colloquiums**. The paper to be presented to the colloquium is a part of Doctoral thesis. Doctoral student submits to the program’s leader (scientific advisor) the printed and electronic versions of paper to be presented to the colloquium. The printed copies of paper are to be sent out for review to person/persons having appropriate academic degree and qualification or to recognized industry experts. **Practice**. Doctoral program envisages the completion of educational practice (assistance to Professor) with direct participation of scientific advisor and representative of the faculty of Pedagogics and/or recognized industry expert. This aims to give Doctoral student as much support as possible to become a future teacher and to develop relevant skills. |
| **Structure of the Program** |
|  The volume of the educational component of the PhD program is 45 credits:**The educational component makes up 45 credits:*** General courses and seminar classes – 30credits (I, II, III semesters)
* Concentration elective courses - 15 credits (I semester)

Prereqisittes for presentation of Doctoral thesis to the public discussions before the Dissertation Commission are as follows: 1. Submission of a spreadsheet confirming earning 45 credits envisaged for educational component to the Faculty’s Dissertation Council. This spreadsheet is issued by Office of Doctoral Studies and it is signed by Rector and Head of Office.
2. Submission of a protocol of the completion of at least three colloquiums envisaged for educational component of the Doctoral program to the Faculty’s Dissertation Council. The completion of colloquiums is confirmed by the certificate issued by Office of Doctoral Studies, which certifies the completion of at least three colloquiums and the assessments of colloquiums. This certificate is signed by rector of University and Head of Office of Doctoral Studies. Methodology for assessing these colloquiums is determined by the Order No 3 of 5 January 2017 of the Minister of Education and Science of Georgia (Article 4, paragraph 17. The assessment of the colloquium is considered positive, if he/she receives a), b), c), d) and e) assessments envisaged by this Article. In case of f) assessment, Doctoral student has the right to pass the revised version of the same colloquium in the next semester, but in case of g) assessment. Doctoral student has to redo the colloquium.
3. At least **3 publications** determined by the Faculty’s Dissertaton Council, in the editions approved by the Faculty’s Dissertaton Council, which are confirmed by submitting the article; the author of dissertation can also to submit a monograph. This monograph is a printed publication of description of problems relating to the dissertation topic, way to and methods to address them and the obtained results of research, in **journals and books with ISBN, ISSN codes**, such as: Messenger of Georgian Academy of Sciences, Messenger of Akaki Tsereteli State University, Georgian Engineering News, collected papers of Georgian Technical University, Problems of Mechanics (Tbilisi), collected papers of the state universities of the Baltic countries, Problems of Metallurgy, Welding and material Science (Tbilisi), International Journal of Mechanical Sciences, Transaction of the American Society of Mechanical Engineers, Problems of Mechanical Engineering and Reliability of Machines (Moscow), Mechanical Engineering and Engineering Education (Moscow), Industrial Laboratory (Moscow), Mechanics of Solids (Moscow), News of Higher Educational Institutions. Mechanical Engineering (Moscow), News of Higher Educational Institutions. Energy (Moscow), Measurement Technology (Moscow), Messenger of Lomonosov State University (Moscow), Mechanical Engineering Messenger (Moscow), Metallurgical Science and Thermal treatment of Metals (Moscow), Strength Problems (Kiev), Applied Mechanics (Kiev), journals listed in a Scopus database, high-rated impact-factor journals (>0,3)

Participation in the conferences, the number of which is determined by the Faculty’s Dissertaton Council and making presentation relating to the topic of dissertation paper, which is confirmed by publishing relevant papers in the proceedings of international conferences, symposia and congresses, and presenting them at the Annual Conferences of Georgian Mechanical Union, Georgian-Polish International Scientific-Technical Conference, Proceedings of the International Conference on Contemporary Problems of Architecture and Construction, International Scientific Conference VIBRATION, International Conference on Non-Classical Problems of Mechanics, Current Issues of Energy, Problems Related to Continuum Mechanics, Proceedings of The conference of Young Scientists of the Institute of Machine Science, and in the international scientific forums organized by the state universities and research institutes of Georgia, CIS and Baltic States. 1. The conclusion of the PhD student's scientific advisor on whether the work is ready for public discussion (Academic Council Decree №62 17/18 1.03.2018 Art.18; paragraph 3);
2. Review of the completed dissertation paper at a special meeting of the Department;
3. Provision of oficial experts by the Faculty’s Dissertation Council, who are to be presented to Rector for approval; the number of official experts and content of their work are determined in accordance with Regulation No 1 (Article 19) of 5 September.
4. In case of positive assessment from official experts, 2 or 3 reviewers are provided by the Faculty’s Dissertation Council, who are to be presented to Rector for approval; decision on whom to appoint as official reviewers is made in accordance with Regulation No 1 (Article 20) of 5 September 2007 of the Academic Council of Akaki Tsereteli State University, and Resolution No 40(14/15) of 22 December 2014 of the Academic Council of Akaki Tesereteli State University; if more than half the reviewers asess dissertation negatively, Doctoral student is not permitted to defend his/her dissertation; if one of two reviewers makes negative conclusion on dissertation paper, the Dissertation Council is to provide the third reviewer within a period of 10 days.
5. In case of positive assessment from official reviewers, Doctoral student is permitted to present publicly dissertation to the Dissertation Commission provided by the the Faculty’s Dissertation Council. The Dissertation Commission provided by the the Faculty’s Dissertation Council is presented to Rector for approval; the composition of the Dissertation Commission is determined in accordance with Regulation No 1 (Article 21) of 5 September 2007 of the Academic Council of Akaki Tsereteli State University, Resolution No 17 (09/10) of 6 November 2009 of the Academic Council of Akaki Tsereteli State University and Resolution No 61 (14/15) of 7 May 2015 of the Academic Council of Akaki Tsereteli State University;
6. Rules for the assessment of dissertation paper are specified in paragraph 17 of article 4 of Order No 3 of 5 January 2007 of the Minister of Education and Science of Georgia, and in Resolution No 17 (09/10) of 6 November 2009 of the Academic Council of Akaki Tsereteli State University.

In case of successful completion of dissertation paper, the Faculty’s Dissertation Council awards students the Doctor’s academic degree(Resolution No 62 (17/18) of 1.03.2018, Article 25)and presents to Rector for approval the project awarding the Doctor’s academic degree to Doctoral student. **see attached document 1** |
| **Assessment System** |
| The common goal of the assessment system is to provide qualitative assessment of Doctoral student’s performance of individual component of Doctoral program, taking into account consistency of the achieved results with the Program’s objectives. The basic principles of the assessment are as follows:* the principle of transparency and publicity – accessibility to the assessment methods and criteria and providing preliminary information;
* the principle of equality and universality – ensuring a unified approach to each Doctoral student when assessing manifested knowledge, using uniform, predefined principles.

The assessment of Doctoral students performance is carried out in accordance with Order No 3 of 5 January 2007 of the Minister of Education and Science of Georgia (as amended), and in accordance with rules set by the Academic Council.Within the educational component of educational program, the assessment system of Doctoral student performance envisages:a) Mid-term assessment;b) Activity assessment. c) Final examination assessment. Maximum course assessment score is 100 points.The maximum score for final examination is 40 points. The minimum assessment score of student at Final Examination is 15 points. Doctoral student has the right to take the final exam, if his/her minimum assessment score at mid-term examination is 18 points. The course is considered completed, if the assessment total score of written tests is 51 points and over. The students grading scheme includes:a) five types of positive assessment:(A) Excellent – 91-100 points. (B) Very good – 81-90 points.  (C) Good – 71-80 points.  (D) Satisfactory – 61-70 points. (E) Acceptable – 51-60 points. b) two types of negative assessment:(FX) Student could not pass examination – 41-50 point that means that Doctoral student is required to work more for passing the exam, and that she/he is entitled to retake exam only once after individual work;(F) failed to pass –40 points and lower that means that the work done by Doctoral student is not sufficient and she/he has to redo the course. Within the educational component of the educational program, in case of FX assessment, a makeup exam is appointed no later than 5 days since the announcement of the examination results. The number of points received in a makeup examination is a final assessment score and is not added to the final assessment received by Doctoral student, and it will be reflected in final assessment of educational component. With account for the assessment received in educational component, in case of final assessment score 0-50 points, Doctoral student is assessed at F-0 point.PhD student’s performance assessment in separate disciplines can be made by different activities, such as: mid-term examination, final examination, execution of targeted written work, individual assignment and so on. The assessment criteria are different following from the specifics of separate disciplines as it set down in the appropriate Syllabuses. The assessment of educational practice is carried out in accordance with an educational practice record list form adopted by Resolution No 76 (10/11) of 28April 2011 of the Academic Council of Akaki Tsereteli State University.Seminar classes are assessed in accordance in accordance with a special mid-term exam and seminal record list adopted by the University. The following assessment systems are used for the assessment of Doctoral student’s dissertation paper: a) Excellent (summa cum laude) –with highest honor; b) Very good (magna cum laude) – with great honor; c) Good (cum laude) – with outstanding honor;  d) Mean (bene) – meets all requirements;  e) Satisfactory (rite) – meets requirements, despite some shortcomings;  f) Unsatisfactory (insufficienter) – does not meet requirements because of substantial shortcomings;  g) Far from satisfactory (sub omni canone) – failed outright.  |
| **Employment opportunities** |
| Graduates would be qualified for employment in:• the university-based education system in the engineering field;• industry enterprises;• research institutions;• expertise bureaus;* • the management bodies in engineering field. government and self-government bodies.
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| **Supportive resources**  |
| * library of the Faculty of Technical Engineering, electronic library;
* for numerical calculations and studies, there exists the computer-based resource-center with appropriate software packages;
* experimental studies will be carried out in the Faculty’s laboratories (Metrology of Processes and Apparatus, Materials Science, Material Mechanics, Metal Constructions, Welding Processes, Building Materials, material technological treatment processes, laboratory base of the Energy Department) and in the laboratories of partner organizations (Ferdinand Tavadze Institute of Metallurgy and Materials Science, Zestafoni N. Nikoladze Ferro alloy Plant).
* the University’s electronic library to provide students with access to international periodicals in the field or interest.
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Attachment1

**PhD Program – Engineering Technologies and Systems**

**Study Program**

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| --- | --- | --- | --- | --- | --- | --- | --- |
| № | **Course title** |  | Number of credits | Number of hours | lec/pr/lab/gr | Semester | Prerequisite  |
|  |  |  |  | Total | Contact hours | Ind. |  | I | II | III | IV | V | VI | VII | VIII |  |
| Classes | Midterm and final exams |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| 1 | **I educational component** |
| **1.** | **General courses and seminars** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1.1 | Modern methods of teaching in engineering |  | 5 | 125 | 30 | 2 | 93 |  | 5 |  |  |  |  |  |  |  |  |
| 1.2 | Teaching practice |  | 5 | 125 | 30 | 2 | 93 |  |  | 5 |  |  |  |  |  |  | 1.1. |
| 1.3 | Seminar1 |  | 5 | 125 | 30 | 2 | 93 |  |  | 5 |  |  |  |  |  |  | \* |
| 1.4 | Seminar 2 |  | 5 | 125 | 30 | 2 | 93 |  |  |  | 5 |  |  |  |  |  | \* |
| 1.5 | Modern methods of research in engineering  |  | 5 | 125 | 30 | 2 | 93 |  | 5 |  |  |  |  |  |  |  |  |
| 1,6 | **Elective courses** |  |  |  |  |  |  |  | 5 |  |  |  |  |  |  |  |  |
| 1.6.1 | Project Risk management |  | 5 | 125 | 30 | 2 | 93 |  |  |  |  |  |  |  |  |  |  |
| 1.6.2 | Numerical methods in engineering |  | 5 | 125 | 30 | 2 | 93 |  |  |  |  |  |  |  |  |  |  |
|  | **Total** |  | **30** |  |  |  |  |  | **15** | **10** | 5 |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **2.** | **Module 1: Materials engineering and quality management (elective courses)**  |  |  |  |  |  |  |  | **15** |  |  |  |  |  |  |  |  |
| 2.1 | Physical adaptive material |  | 5 | 125 | 30 | 2 | 93 |  | 5 |  |  |  |  |  |  |  |  |
| 2.2 | Assessment of the quality technical condition of products |  | 5 | 125 | 30 | 2 | 93 |  | 5 |  |  |  |  |  |  |  |  |
| 2.3 | Innovative methods for obtaining materials  |  | 5 | 125 | 30 | 2 | 93 |  | 5 |  |  |  |  |  |  |  |  |
| 2.4 | Foundations of the mechanical equipment reliability  |  | 5 | 125 | 30 | 2 | 93 |  | 5 |  |  |  |  |  |  |  |  |
| 2.5 | Tribological processes  |  | 5 | 125 | 30 | 2 | 93 |  | 5 |  |  |  |  |  |  |  |  |
| 2.6 | Modern methods and means of measurement  |  | 5 | 125 | 30 | 2 | 93 |  | 5 |  |  |  |  |  |  |  |  |
|  | **Total** |  | **15** |  |  |  |  |  | **15** |  |  |  |  |  |  |  |  |
| **3.** | **Module 2: Engineering structures (elective courses)** |  |  |  |  |  |  |  | **15** |  |  |  |  |  |  |  |  |
| 3.1 | Mechanics of engineering thin-walled spatial structures  |  | 5 | 125 | 30 | 2 | 93 |  | 5 |  |  |  |  |  |  |  |  |
| 3.2 | Building materials and resource-saving technologies  |  | 5 | 125 | 30 | 2 | 93 |  | 5 |  |  |  |  |  |  |  |  |
| 3.3 | Creep and rupture of materials  |  | 5 | 125 | 30 | 2 | 93 |  | 5 |  |  |  |  |  |  |  |  |
| 3.4 | Constructions calculating models  |  | 5 | 125 | 30 | 2 | 93 |  | 5 |  |  |  |  |  |  |  |  |
| 3.5 | Finite element method in mechanics  |  | 5 | 125 | 30 | 2 | 93 |  | 5 |  |  |  |  |  |  |  |  |
| 3.6 | Stability of engineering structures  |  | 5 | 125 | 30 | 2 | 93 |  | 5 |  |  |  |  |  |  |  |  |
| 3.7 | Thermal treatment of materials and constructions  |  | 5 | 125 | 30 | 2 | 93 |  | 5 |  |  |  |  |  |  |  |  |
| 3.8 | Methods for optimizing motor roadparameters  |  | 5 | 125 | 30 | 2 | 93 |  | 5 |  |  |  |  |  |  |  |  |
| 3.9 | Motor roads reliability  |  | 5 | 125 | 30 | 2 | 93 |  | 5 |  |  |  |  |  |  |  |  |
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|  | **Total** |  | **15** |  |  |  |  |  | **15** |  |  |  |  |  |  |  |  |
| **4.** | **Module 3. Power industry technology and management (elective courses)**  |  |  |  |  |  |  |  | **15** |  |  |  |  |  |  |  |  |
| 4.1 | Theory of similarity and simulation(with regard to power industry problems)  |  | 5 | 125 | 30 | 2 | 93 |  | 5 |  |  |  |  |  |  |  |  |
| 4.2 | Planning and prognosis in power industry |  | 5 | 125 | 30 | 2 | 93 |  | 5 |  |  |  |  |  |  |  |  |
| 4.3 | Fundamentals of energy security  |  | 5 | 125 | 30 | 2 | 93 |  | 5 |  |  |  |  |  |  |  |  |
| 4.4 | Models of Problem Solving |  | 5 | 125 | 30 | 2 | 93 |  | 5 |  |  |  |  |  |  |  |  |
| 4.5 | Special regimes of the electrical systems  |  | 5 | 125 | 30 | 2 | 93 |  | 5 |  |  |  |  |  |  |  |  |
| 4.6 | Energy strategies and policy  |  | 5 | 125 | 30 | 2 | 93 |  | 5 |  |  |  |  |  |  |  |  |
|  | **Total** |  | **15** |  |  |  |  |  | **15** |  |  |  |  |  |  |  |  |
| **5.** | **Module 4: Mathematical modeling of engineering processes and systems (elective courses)**  |  |  |  |  |  |  |  | **15** |  |  |  |  |  |  |  |  |
| 5.1 | Continuum mechanics |  | 5 | 125 | 30 | 2 | 93 |  | 5 |  |  |  |  |  |  |  |  |
| 5.2 | Theory of similarity and simulation |  | 5 | 125 | 30 | 2 | 93 |  | 5 |  |  |  |  |  |  |  |  |
| 5.3 | General basics of mathematical modeling  |  | 5 | 125 | 30 | 2 | 93 |  | 5 |  |  |  |  |  |  |  |  |
| 5.4 | Method of finite elements in mechanics |  | 5 | 125 | 30 | 2 | 93 |  | 5 |  |  |  |  |  |  |  |  |
| 5.5 | Mechanics of composite materials  |  | 5 | 125 | 30 | 2 | 93 |  | 5 |  |  |  |  |  |  |  |  |
| 5.6 | Creep and rupture of materials  |  | 5 | 125 | 30 | 2 | 93 |  | 5 |  |  |  |  |  |  |  |  |
| 5.7 | Mechanics of technological processes of materials treatment  |  | 5 | 125 | 30 | 2 | 93 |  |  |  |  |  |  |  |  |  |  |
| 5.8 | Models of calculating the constructions |  | 5 | 125 | 30 | 2 | 93 |  |  |  |  |  |  |  |  |  |  |
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| 5.9 | Theory of mechanical vibrations  |  | 5 | 125 | 30 | 2 | 93 |  |  |  |  |  |  |  |  |
| 5.10 | Membrane technology  |  | 5 | 125 | 30 | 2 | 93 |  |  |  |  |  |  |  |  |  |  |
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|  | **Total** |  | **15** |  |  |  |  |  | **15** |  |  |  |  |  |  |  |  |
|  | Educational component  |  | **45** | **1125** |  |  |  |  | 30 | 10 | 5 |  |  |  |  |  |  |
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