

REPUBLIC OF UZBEKISTAN
MINISTRY OF HIGHER EDUCATION, SCIENCE AND INNOVATIONS
FERGANA STATE TECHNICAL UNIVERSITY

Active Seismic Protection Systems for Buildings and Structures

MODULE HANDBOOK

Field of knowledge: 700000 – Engineering and construction industries

Field of Education: 730 000 - Architecture and construction

Educational program: 60730300 - Civil Engineering

Module title	<i>Active Seismic Protection Systems for Buildings and Structures</i>
Code (if available)	<i>AEPSBST76</i>
Semester(s) of module teaching	<i>7</i>
Responsible for the module	<i>Abobakirova Zebuniso Asrorovna, PhD, docent, Department of Civil Engineering</i>
Language of instruction	<i>Uzbek</i>
Connection to the curriculum	<i>elective</i>
Teaching methods	<i>lectures, practical training, independent study</i>
Study load (including classroom and independent study hours)	<i>Total hours: 180 hours Auditorium hours: 72 hours Lecture– 22 hours, practical training– 50 hours, Independent study - 108 hours.</i>
Credit units	6
Required and recommended prior knowledge for studying the module	<i>Construction Structures, Structural Mechanics, Theoretical Mechanics, Soil Mechanics</i>
Module objectives/intended learning outcomes	Module Objective: <i>The aim of the course is to develop students' knowledge and skills necessary for studying and synthesizing scientific and technical literature related to structural design—one of the key stages of engineering design. Students are expected to master methods for compiling concise, generalized information and be able to analyze and interpret the results of theoretical and applied research. Special attention is given to the use of computational tools and software for processing analytical data. The course familiarizes students with the essence, content, and areas of application of modern active seismic protection systems for buildings and structures. The discipline addresses the application of active seismic protection devices, examines the dynamic behavior of structures equipped with various types of seismic protection systems, and determines their stress-strain states under seismic loading. The course is aimed at developing the appropriate knowledge, practical skills, and professional competencies required in the field of earthquake-resistant structural design.</i> <i>The course sets forth the following requirements for students' knowledge, skills, and competencies.</i> <i>Students are expected to have an understanding and knowledge of the following topics:</i> <i>- design of active seismic protection devices, dampers, actuators, and seismic protection systems, as well as issues related to enhancing the seismic resistance of buildings and structures; dynamics, priority, oscillatory motion, degrees of freedom, single-degree-of-freedom systems, and multiple-degree-of-freedom systems; Free vibration, damped vibration, and forced “vibration; dynamic and static loads, types of dynamic loads; harmonic excitation, impulse, impact, seismic force, accelerogram; calculation of frames under dynamic loads, dynamic characteristics of buildings, frame analysis considering priority; calculation of cross-sections of constant and variable compressive members under priority; differential equations, methods for solving systems of differential equations;</i>

	determination of dynamic characteristics of buildings and calculation of seismic forces; Structural schemes of buildings and structures and their kinematic analysis; displacement method in frame analysis considering priority; methods for calculating statically determinate and indeterminate systems; application of active seismic protection devices and design considering their effects, among others. - Mastering the theoretical foundations of the discipline and computational formulas for solving practical problems; correct selection of structural calculation models for buildings and structures; analysis of seismic resistance of structures considering the effects of active seismic protection systems; design of dampers, shock absorbers, and seismic protection devices; determination of forces acting on structural elements through the study of vibrational motions; conducting investigations of vibrational behavior in structures; - Calculation and design of building and structure elements under the influence of dynamic forces; analysis of buildings and structures subjected to seismic forces in accordance with regulatory document requirements; dynamic calculation schemes. investigations of vibrational behavior in structures. Calculation and design of building and structure elements under the influence of dynamic forces, calculation of buildings and structures under the influence of seismic forces and work with the requirements of regulatory documents; analysis and calculation of dynamic calculation schemes; determination of dynamic indicators and determination of dynamic forces; study of vibrational motion; selection of schemes and their kinematic analysis; determination of stresses and displacements in structures taking into account active seismic protection devices; must have the skills to calculate statically precise and uncertain systems.
Content	Module 1. Active and Passive Protection Systems and Their Classification Introduction. Core objectives and tasks of the course. Active and passive protection systems and their classification. Traditional seismic protection measures applied in architectural monuments and their analysis. Module 2. Seismic Vibration Damping Seismic vibration damping. Dampers, actuators, and suppressors, and their significance in vibration attenuation. Dampers with dry and viscous friction, their main characteristics, and mathematical models. Module 3. Structural Systems Used in Modern Multi-Story Buildings Regulatory requirements for structural systems applied in modern multi-story buildings. General principles of designing earthquake-resistant buildings. Requirements for spatial-planning and urban development solutions of buildings located in seismically active regions Module 4. Seismic Protection of Buildings and Structures Seismic protection of buildings and structures. Methodology for

	<i>the investigation of earthquake-resistant buildings. Seismic protection systems for buildings. Multi-story buildings in the Republic of Uzbekistan employing current seismic protection systems and their technical condition.</i> Module 5. Methodology for Determining Seismic Forces <i>Spectral method for determining seismic forces. Determination of seismic forces in accordance with building codes and standards. Methodology for seismic force determination. Approximate methods for solving equations.</i>
Forms of assessment	<i>Oral responses, presentations, written works, practical assignments, and final exams.</i>
Requirements for study and assessment	<i>To successfully complete the module, the student must attend classes and obtain the minimum required scores in current, midterm, and final assessments..</i>
Bibliography	1. Sh.A. Umarov, Z.A. Abobakirova. <i>Earthquake Resistance of Buildings and Structures. Textbook for the specialty 70730301 – Construction of Buildings and Structures (by types of structures). Based on Order No. 388 dated November 25, 2022, registration No. 263. CLASSIC Publishing, ISBN: 978-6200-639-639, Fergana, 2022.</i> 2. E.M. Yunusaliyev, I.N. Abdullayev, Sh.M. Davlyatov, Z.A. Abobakirova. <i>Earthquake Resistance of Buildings and Structures. Study guide for students of the bachelor's program 5340300 – Urban Construction and Management. CLASSIC Publishing, ISBN: 978-9943-7532-3-5, Classification Code: 568.66.23, 2021.</i> 3. Z.A. Abobakirova. <i>Earthquake Resistance of Buildings and Structures. Textbook for the bachelor's program in Construction of Buildings and Structures (by types of structures). Based on Order No. 391 dated August 25, 2023, registration No. 377706.</i> 4. A.I. Rusakov. <i>Fundamentals of Structural Mechanics, Dynamics, and Stability. Slovak language. Taylor & Francis Group, LLC, 2021.</i> 5. T.R. Rashidov, S.V. Kuznetsov, B.M. Mardonov, I. Mirzaev. <i>Applied Problems of Seismic Dynamics of Structures. Volume 1. "Effect of Seismic Waves on Underground Pipelines and Foundations of Structures Interacting with Soil." Tashkent: Navro'z Publishing, 2019, 268 pages.</i>
Reviewers	<i>E.M. Yunusaliyev – (DSc) docent, Department of Civil Engineering, Fergana State Technical University</i> <i>O.J. Rakhmonov – Head of Construction Testing Laboratory and Structural Condition Division, Regional Construction Inspection, Fergana Region</i>