APPENDIX - C1:

DESCRIPTION OF CURRICULUM PER OBLIGATORY AND OPTIONAL SUBJECTS WITHIN THE IZIIS' MASTER STUDIES IN STRUCTURAL ENGINEERING AND SEISMIC DESIGN (Programme-1)

Subject:	*DYNAMICS OF STRUCTURES*			
Code	***Status***	***Semester***	***Number of ECTS credits***	***Number of lecture hours***
SE&SD-101	***Obligatory***	***I***	***6***	***30***

Curriculum of IZIIS' Postgraduate Studies

Structural Engineering & Seismic Design Major (Curriculum – 1)

Enrollment conditions:

Name and surname of professors (participants in preparation of contents)):

Principal lecturer: **Prof. Dr. Ljubomir Taskov**
Other lecturers: **Assist. Prof. Dr. Lidija Krstevska**
Visiting professors:

Contents of the subject:

1. Single-degree-of freedom systems:
1.1. Equations of motion, definition of problem and methods of solution
1.2. Free vibrations
1.3. Response to harmonic, periodic, random and impulse excitations
1.4. Numerical evaluation of dynamic response
1.5. Seismic response of linear and nonlinear systems
1.6. Generalized single-degree-of-freedom systems.
2. Multi-degree-of-fredom systems:
2.1. Equations of motion, definition of problem and methods of solution
2.2. Free vibrations, damping in structures
2.3. Dynamic analysis and response of linear systems
2.4. Seismic analysis of linear systems
2.5. Reduction of degrees-of-freedom
2.6. Numerical evaluation of dynamic response
2.7. Systems with distributed mass and elasticity.
3. Seismic response and design of multi-storey buildings:
3.1. Seismic response of linear elastic buildings
3.2. Seismic response of inelastic buildings
3.3. Seismic dynamics of base-isolated buildings
3.4. Dynamics of structures in seismic codes for buildings

Method:

Lectures	*Exercises*	*Numerical and Graphical tasks*	*Use of software*	*Laboratory exercises*	*Seminar papers*	*Field lectures*
Yes	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*

Grading:

Attendance of lectures	*Obligatory tasks*	*Colloquia*	*Seminar papers*	*Written examination*	*Oral examination*
Yes	*Yes*	*/*	*Yes*	*Yes*	*Yes*

References: *Main:* ***Dynamics of Structures and Earthquake Dynamics***

Additional: Dynamics of Structures – Marko Paz; Dynamics of Structures – Penzien and Clough, Special chapters from Dynamics of Structures – Trifun Paskalov, Dynamics of Structures – Constantine Mescuris.

	Subject: ANALYSIS OF STRUCTURES			
Code	***Status***	***Semester***	***Number of ECTS credits***	***Number of lecture hours***
SE&SD-102	***Obligatory***	***I***	***6***	***30***

Curriculum of IZIIS' Postgraduate Studies

Structural Engineering & Seismic Design Major (Curriculum – 1)

Enrollment conditions:

Name and surname of professors (participants in preparation of contents)):

Principal lecturer: **Prof. Dr. Danilo Ristic**
Other lecturers: **Assoc. Prof. Dr. Viktor Hristovski**
Visiting professors:

Contents of the subject:

Introduction to structural analysis: classification of loads and structural problems. Theory of advanced matrix structural analysis: theory of elasticity, virtual work principles, energy theorems. Direct stiffness (displacement) method: elements and structure stiffness formulation, solution methods. Flexibility (force) method: concept and applicability. Application of computers: solution strategies, basic linear static and dynamic analysis procedures. Theory of large deflections and stability analysis. Introduction to the theory of analysis of nonlinear structures: fundamentals of plastic analysis of structures. Plastic hinge. Elastic-plastic analysis of beams and frames. Basic principles of analysis of boundary conditions. Influence of axial forces and interaction with bending moments. Fundamentals of FEM application in formulation of models for static analysis. Fundamentals of FEM application in formulation of models for dynamic analysis. General methods for solving dynamic problems: general equation of motion, methods for step by step numerical integration, numerical methods for dynamic equilibrium iterations. Strategies and methods for static and dynamic analysis of large nonlinear systems: methods for computation of initial dynamic characteristics (solution of eigen value and eigen vector). Introduction to static and dynamic analysis of special structures: analysis of complex systems under combined loads, analysis of seismically isolated structures, analysis of structures with energy dissipation and vibration control elements. Introduction to advanced techniques for numerical analysis and computer programming, development of specialized computer software and its practical application for experimental and design purposes, application of modern computer software for scientific and design purposes.

Method:

Lectures	*Exercises*	*Numerical and Graphical tasks*	*Use of software*	*Laboratory exercises*	*Seminar papers*	*Field lectures*
Yes	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*

Grading:

Attendance of lectures	*Obligatory tasks*	*Colloquia*	*Seminar papers*	*Written examination*	*Oral examination*
Yes	*Yes*	*/*	*Yes*	*Yes*	*Yes*

References: *Main: Mimeographed notes for IZIIS-DAAD master studies prepared by Prof. Dr. Danilo Ristic*

Additional: Most renowned reference books and scientific papers from the world scientific literature

	Subject: ENGINEERING MATERIALS			
Code	***Status***	***Semester***	***Number of ECTS credits***	***Number of lecture hours***
SE&SD-103	***Obligatory***	***I***	***6***	***30***

Curriculum of IZIIS' Postgraduate Studies

Structural Engineering & Seismic Design Major (Curriculum – 1)

Enrollment conditions:

Name and surname of professors (participants in preparation of contents)):

Principal lecturer: Assoc. Prof. Dr. Veronika Sendova
Other lecturers: Assist. Prof. Dr. Roberta Apostolska
Visiting professors:

Contents of the subject:

- Introduction to materials science;
- Atomic structure and inter-atomic bonding;
- Failure, fatigue and creep of materials;
- Structure and mechanical properties of metals, ceramics, polymers and composite materials.

Construction Materials:

Cement and concrete materials: characteristics, behaviour and stress-strain relationship for monotonic, cyclic and dynamic loading; advanced concrete, (light-weight concrete, high strength concrete, fiber reinforced concrete, high performance concrete etc.)

Reinforcing and structural steel: material properties, different types of materials and reinforcing steel, stress-strain relationships for monotonic, reversed and dynamic loading.

Masonry: properties of masonry, types of masonry blocks, types of mortar, types of masonry structures.

Wood: structure and properties of wood, wood as construction material, wood products, types of wood structures.

Method:

Lectures	*Exercises*	*Numerical and Graphical tasks*	*Use of software*	*Laboratory exercises*	*Seminar papers*	*Field lectures*
Yes	*/*	*/*	*/*	*Optional*	*/*	*/*

Grading:

Attendance of lectures	*Obligatory tasks*	*Colloquia*	*Seminar papers*	*Written examination*	*Oral examination*
20%	*/*	*30%*	*/*	*30%*	*50%*

References: *Main:Civil Engineering Materials, Shan Somayaji – selected chapters, Materials Science and Engineering – An Introduction, W. D. Callister – selected chapters, Fundamentals of High Performance Concrete, Nawy E., published by John Wiley&Sons, 2nd Edition, January 2000 – selected chapters*

Additional: *Instructive materials prepared by the IZIIS' lecturers in the subject*

	Subject:	GENERAL PRINCIPLES OF DESIGN OF STRUCTURES		
Code	***Status***	***Semester***	***Number of ECTS credits***	***Number of lecture hours***
SE&SD-104	***Obligatory***	***I***	***6***	***30***

Curriculum of IZIIS' Postgraduate Studies

Structural Engineering & Seismic Design Major (Curriculum – 1)

Enrollment conditions: **Construction Materials and Theory of Structures & Application**

Name and surname of professors (participants in preparation of contents)):

Principal lecturer: **Prof. Dr. Golubka Necevska Cvetanovska**
Other lecturers: **Prof. Dr. Zivko Bozinovski**
Visiting professors:

Contents of the subject:

Principles of boundary conditions:

Philosophy of design: design process, fundamentals of design; Boundary conditions and ultimate usabilility conditions; characteristics and design values of strength and loads, partial safety factors.

Main structural concepts:

Design loads acting upon structures (dead loads, life loads, seismic forces, wind forces and other loads); design loads acting upon elements. Combinations of design loads; design of bearing elements of structures. Capacity design philosophy.
Behaviour of concrete (non-confined and confined) under effect of different loads; behaviour of steel under effect of different loads. Nonlinear behaviour of reinforced-concrete elements – interaction diagram M-N.

Method:

Lectures	*Exercises*	*Numerical and Graphical tasks*	*Use of software*	*Laboratory exercises*	*Seminar papers*	*Field lectures*
Yes	*Yes*	*/*	*Yes*	*/*	*Yes*	*/*

Grading:

Attendance of lectures	*Obligatory tasks*	*Colloquia*	*Seminar papers*	*Written examination*	*Oral examination*
10%	*/*	*/*	*20%*	*30%*	*40%*

References: *Main: Eurocode 0 – Basis for Design of Structures*
Additional: *Instructive materials prepared by the IZIIS' lecturers in the subject*

	Subject: EXPERIMENTAL MECHANICS			
Code	***Status***	***Semester***	***Number of ECTS credits***	***Number of lecture hours***
SE&SD-105	***Optional***	***I***	***6***	***30***

Curriculum of IZIIS' Postgraduate Studies

Structural Engineering & Seismic Design Major (Curriculum – 1)

Enrollment conditions: Dynamics of Engineering Structures; Theory of Structures and Application

Name and surname of professors (participants in preparation of contents)):

Principal lecturer: Assist. Prof. Dr. Lidija Krstevska
Other lecturers: Assoc. Prof. Dr. Zoran Rakicevic
Visiting professors:

Contents of the subject:

1. Introduction to experimental mechanics; physical modeling in structural engineering.
2. Theory of physical models: dimensional analysis - Buckingham's theorem, examples; types of physical models, true-replica, adequate and distorted. Linear models; nonlinear models. Characteristics of materials for models ($\sigma-\varepsilon$, ν, ρ, ξ); strain rate effect, simulation of time-dependent effects, size effect, ductility, fabrication. Materials for physical models; plastics, epoxy resins, metals and alloys, micro concrete, gypsum and gypsum-sand mixtures, reinforcement simulation. Modeling of reinforced-concrete, masonry and steel structures – examples.
3. Seismic shaking tables. Characteristics of shaking tables; size, material, mass, kinematic properties, overturning moment, foundation, displacement, velocity and acceleration. Field of usage. Degrees of freedom. Control of motion. Examples.
4. Pseudo-dynamic testing of models. Reaction walls.
5. Quasi-static testing of elements, ensembles and structures. Definition, field of application and identified quantities; $P-\Delta$; $M-\Phi$; $\sigma-\varepsilon$; stiffness and deformability, ductility and energy dissipation. Equipment. Quasi-static testing procedure. Loading histories. Controlled quantities. Examples of quasi-static testing: wall systems, frame structures, systems with shear walls, steel systems.
6. Full-scale testing of structures. Needs and objective of tests; testing methods; forced vibration testing: theory, equipment, procedure, identified characteristics; Ambient vibration method: theory, equipment, testing procedure and identified quantities. Applicative software for data processing. Examples.
7. Instrumentation of structures and models – principles and application. Gauges. Static and dynamic characteristics of gauges. Load transducers, accelerometers, displacement transducers, strain gauges. Wheatstone bridge; measurement of axial force, moment. Acquisition of data.
8. Analysis of experimental data. Errors in experimental testing of models of structures. Statistic analysis. Probabilistic analysis. Method of data fitting. Least square method.

Method:

Lectures	*Exercises*	*Numerical and Graphical tasks*	*Use of software*	*Laboratory exercises*	*Seminar papers*	*Field lectures*
Yes	/	*Yes*	/	*Yes*	*Yes*	*Yes*

Grading:

Attendance of lectures	*Obligatory tasks*	*Colloquia*	*Seminar papers*	*Written examination*	*Oral examination*
Yes	/	/	*Yes*	*Yes*	*Yes*

References: *Main: Instructive material prepared by the lecturers*
Additional: *Papers and other materials, video materials*

	Subject: GEOTECHNICAL ENGINEERING			
Code	***Status***	***Semester***	***Number of ECTS credits***	***Number of lecture hours***
SE&SD-106	***Optional***	***I***	***6***	***30***

Curriculum of IZIIS' Postgraduate Studies

Structural Engineering & Seismic Design Major (Curriculum – 1)

Enrollment conditions:

Name and surname of professors (participants in preparation of contents)):

Principal lecturer: **Assist. Prof. Dr. Vlatko Sesov**
Other lecturers: **Assist. Prof. Dr. Violeta Mircevska**
Visiting professors:

Contents of the subject:

I. Nature and composition of soils
Soil formations and soil deposits
Phase relations
Classification of soil

II. Stress and Strain
Drainage conditions
Anisotropy
Apparata for testing of soil
Stress-strain relationships
Theory of critical conditions

III. Geotechnical structures
Earth retaining structures
Diaphragm walls
Slope stability analysis
Shallow foundation
Pile foundation

IV. Performances and functioning of structures
Deformation of soil and structures
Methods of analysis
Proportioning of foundation
Laterally loaded pile foundation
Deformation due to construction excavation

Method:

Lectures	*Exercises*	*Numerical and Graphical tasks*	*Use of software*	*Laboratory exercises*	*Seminar papers*	*Field lectures*
Yes	*Yes*	*Yes*	*Yes*	/	/	/

Grading:

Attendance of lectures	*Obligatory tasks*	*Colloquia*	*Seminar papers*	*Written examination*	*Oral examination*
Yes	*Yes*	/	/	*Yes*	/

References: *Main: Geotechnical Engineering by Renato Lancelota, Balkema 1979; Analysis and Design of Foundation by J.E. Bowles*
Additional: *Soil Mechanics, SI Version, by T. V. Lambe, R. V. Vitman, 1979.*

	Subject:	*FUNDAMENTALS OF EARTHQUAKE ENGINEERING AND ENGINEERING SEISMOLOGY*		
Code	***Status***	***Semester***	***Number of ECTS credits***	***Number of lecture hours***
SE&SD-107	***Optional***	***I***	***6***	***30***

Curriculum of IZIIS' Postgraduate Studies

Structural Engineering & Seismic Design Major (Curriculum – 1)

Enrollment conditions:

Name and surname of professors (participants in preparation of contents)):

Principal lecturer: **Prof. Dr. Mihail Garevski**
Other lecturers: **Prof. Dr. Golubka N. Cvetanovska**
Prof. Dr. Danilo Ristic
Prof. Dr. Zoran Milutinovic
Visiting professors:

Contents of the subject:

Introduction to engineering seismology: seismicity; earthquake faults and waves; earthquake records and response spectra;

Single degree of freedom systems: equations of motion, problem statement and solution methods; numerical evaluation of dynamic response; response of linear systems to earthquakes;

Multi degree of freedom systems: equations of motion, problem statement and solution methods; free vibration, damping in the structure; response of linear systems; analysis of seismic response of linear systems

Earthquake response of multi-story buildings: earthquake response of linear elastic buildings; structural dynamics in building codes; seismic equivalent static forces; time-history response analysis; response spectrum analysis; building codes concept.

Industrial buildings: seismic design of industrial buildings: mathematical models, seismic response analysis, application of codes; diagnosis of conditions of existing industrial buildings, expert analyses; repair and strengthening of industrial buildings: analytical modelling, as built design, realization, verification; seismic instrumentation of industrial buildings; analysis of seismic vulnerability of industrial buildings; maintenance and functioning.

Learning from past earthquakes - damages to different structures during recent earthquakes. Behaviour of structures under earthquake and dynamic loads.

Basic principles of earthquake resistant design of building structures and safety criteria: methodology and approach to seismic design of structures.

Philosophy of capacity design: **(**main features, illustrative analogy, capacity design of structures, illustrative example).

Method:

Lectures	*Exercises*	*Numerical and Graphical tasks*	*Use of software*	*Laboratory exercises*	*Seminar papers*	*Field lectures*
Yes	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*

Grading:

Attendance of lectures	*Obligatory tasks*	*Colloquia*	*Seminar papers*	*Written examination*	*Oral examination*
Yes	*Yes*	*/*	*Yes*	*Yes*	*Yes*

References: *Main: Seismic design of reinforced concrete and masonry structures, Pauley and Pristley, 1992, Dynamics of Structures and Dynamics of Earthquakes, Anil Chopra*

Additional: Instructive materials prepared by IZIIS' lecturers in the subject

	Subject:	INTRODUCTION TO MATLAB AND ITS APPLICATION IN ENGINEERING ANALYSES		
Code	***Status***	***Semester***	***Number of ECTS credits***	***Number of lecture hours***
SE&SD-108	***Optional***	***I***	***6***	***30***

Curriculum of IZIIS' Postgraduate Studies

Structural Engineering & Seismic Design Major (Curriculum – 1)

Enrollment conditions:

Name and surname of professors (participants in preparation of contents)):

Principal lecturer: Dr. Katarina Manova, Scientific Collaborator
Other lecturers:
Visiting professors:

Contents of the subject:

Introduction to MATLAB and its application in solving problems in the domain of engineering and applied mathematics.

MATLAB starting; some useful commands: syntax, main operators, numbers and formats.

Use of MATLAB in linear algebra: vectors and vector operations in MATLAB; main operations with matrices in MATLAB, determinants, inverse and transposed matrices, special matrices; characteristic values and characteristic vectors of matrices (eigenvalues and eigenvectors of matrices); solving of systems of linear equations; application in linear algebra.

Numerical analyses with MATLAB: MATLAB functions; roots of polynoms; zero functions; interpolations; numerical integrations and derivations.

Use of graphics in MATLAB: 2-dimensional graphics, main drawings, multiplots, subplots; 3-dimensional graphics, plotting of three-dimensional structures and surfaces. Flow-control instructions in MATLAB: for loop; while loop, if statement.

Programming in MATLAB: mimeographed notes and functional programmes.

Method:

Lectures	*Exercises*	*Numerical and Graphical tasks*	*Use of software*	*Laboratory exercises*	*Seminar papers*	*Field lectures*
Yes	*Yes*	*Yes*	*Yes*	*Yes*	*/*	*/*

Grading:

Attendance of lectures	*Obligatory tasks*	*Colloquia*	*Seminar papers*	*Written examination*	*Oral examination*
20%	*30%*	*/*	*30%*	*/*	*50%*

References: *Main: MATLAB Primer, Kermit Sigmon, An Introduction to MATLAB, David F. Griffiths, An Introduction to Numerical Linear Algebra, Charles G. Cullen, 1994, Selected chapters, Numerical Mathematics and Computinng, Ward Cheney, David Kincaid, 1999, selected chapters*

Additional: *Instructive materials prepared by the IZIIS' lecturer in the subject.*

	Subject: REINFORCED CONCRETE STRUCTURES			
Code	***Status***	***Semester***	***Number of ECTS credits***	***Number of lecture hours***
SE&SD-201	***Obligatory***	***II***	***6***	***30***

Curriculum of IZIIS' Postgraduate Studies

Structural Engineering & Seismic Design Major (Curriculum – 1)

Enrollment conditions: Engineering Materials

Name and surname of professors (participants in preparation of contents)):

Principal lecturer: Prof. Dr. Golubka Necevska Cvetanovska
Other lecturers: Assist. Prof. Dr. Roberta Apostolska
Visiting professors:

Contents of the subject:

Introduction: characteristics of concrete and reinforcing steel as materials; behaviour of concrete and steel under the effect of monotonous and cyclic loads; analysis of ultimate states and behaviour of reinforced concrete elements under bending, shear, axial load and torsion.

Confinement, bending, connection and anchorage effects; effect upon reinforced concrete elements and structures; design of reinforced concrete structures, philosophy of design, design according to different regulations. Design of reinforced concrete elements (beams, slabs, columns and shear walls); proportioning and preparation of details for reinforced-concrete structures by taking into account vertical and horizontal loads.

Definition of strength and ductility capacity of building elements and structures.

Methodology for assessment of resistance of reinforced concrete structures exposed to different loads.

Requirements related to analysis, design and preparation of details for reinforced concrete structures according to the regulations.

Method:

Lectures	*Exercises*	*Numerical and Graphical tasks*	*Use of software*	*Laboratory exercises*	*Seminar papers*	*Field lectures*
Yes	*Yes*	*/*	*Yes*	*/*	*Yes*	*/*

Grading:

Attendance of lectures	*Obligatory tasks*	*Colloquia*	*Seminar papers*	*Written examination*	*Oral examination*
10%	*/*	*2 x 20%*	*40%*	*40%*	*10%*

References:

Main: Reinforced Concrete Structures, Park and Poley 1975, Eurocode 2 – Design of Concrete Structures, Part 1-1, General Rules for Buildings

Additional: *Instructive materials prepared by IZIIS' lecturers in the subject*

	Subject:	APPLICATION OF FEM IN ANALYSIS OF STRUCTURES		
Code	***Status***	***Semester***	***Number of ECTS credits***	***Number of lecture hours***
SE&SD-202	***Obligatory***	***II***	***6***	***30***

Curriculum of IZIIS' Postgraduate Studies

Structural Engineering & Seismic Design Major (Curriculum – 1)

Enrollment conditions: Theory of Structures & Application

Name and surname of professors (participants in preparation of contents)):

Principal lecturer: Assoc. Prof. Dr. Viktor Hristovski
Other lecturers: Prof. Dr. Danilo Ristic
Visiting professors:

Contents of the subject:

1. Introduction to FEM;
2. Weighted-integral and weak formulations: need for weighted-integral forms, derivation of the weak form for a given differential equation, variational methods of approximation, the Rayleigh-Ritz method;
3. Finite elements of an elastic continuum: basic relations within an element, generalizations to the whole region, displacement approach as a minimization of total potential energy.
4. Plane stress and plane strain;
5. Axisymmetric stress analysis: plane strain as a special case of axisymmetry;
6. Three-dimensional stress analysis;
7. Shape functions: standard and hierarchical concept, standard shape functions, rectangular elements – serendipity family, triangular elements, area coordinates for triangles, three-dimensional rectangular prisms;
8. Mapped elements and numerical integration: parametric curvilinear coordinates, transformations, numerical integration;
9. Patch test for element validation: convergence requirements, the simple patch test (forms a and b) – necessary condition for convergence, generalized patch test (test c), example with a bar element;
10. Implementation of iso-parametric elements into computer code: introduction, preparation of input file, FORTRAN code, interpretation of results obtained by FEM analysis.

Method:

Lectures	*Exercises*	*Numerical and Graphical tasks*	*Use of software*	*Laboratory exercises*	*Seminar papers*	*Field lectures*
Yes	*Yes*	*Yes*	*Yes*	*/*	*Yes*	*/*

Grading:

Attendance of lectures	*Obligatory tasks*	*Colloquia*	*Seminar papers*	*Written examination*	*Oral examination*
5%	*5%*	*/*	*20%*	*35%*	*35%*

References: *Main: Finite Element Method by O. C. Zienkieviz and R. P. Taylor, 4th edition, 1989*
Additional: FEM Procedures, K. J. Bath, Prentice Hall, 1996, Introduction to FEM, J. H. Reddy

	Subject:	PLANNING AND MANAGEMENT OF PROJECTS		
Code	***Status***	***Semester***	***Number of ECTS credits***	***Number of lecture hours***
SE&SD-203	***Obligatory***	***II***	***6***	***30***

Curriculum of IZIIS' Postgraduate Studies

Structural Engineering & Seismic Design Major (Curriculum – 1)

Enrollment conditions:

Name and surname of professors (participants in preparation of contents)):

Principal lecturer: Prof. Dr. Mihail Garevski
Other lecturers:
Visiting professors:

Contents of the subject:

Today, the necessity of planning and management of projects is imposed in all the activities of human life. The projects are becoming increasingly complex wherefore there is a need of training of staff, who will deal with this problem in future. Planning and management of projects is needed also when constructing complex structures or structures requiring big investments. Knowledge in planning of projects is necessary even when big scientific-research and educative projects (local and international large scale projects) are to be carried out. The contents proposed for this subject are the following:

1. Project Management Environment
2. Project Organization
3. Planning and Management of Human and Other Resources
4. Financial Planning and Managing of Project
5. Project Control
6. Project Communications
7. Computer Applications in Project Design

Method:

Lectures	*Exercises*	*Numerical and Graphical tasks*	*Use of software*	*Laboratory exercises*	*Seminar papers*	*Field lectures*
Yes	/	/	*Yes*	/	*Yes*	/

Grading:

Attendance of lectures	*Obligatory tasks*	*Colloquia*	*Seminar papers*	*Written examination*	*Oral examination*
5%	*30%*	/	/	*50%*	*15%*

References: *Main: Materials recommended by the lecturer in the subject*
Additional:Selected scientific papers

	Subject:	STEEL, MASONRY AND TIMBER STRUCTURES		
Code	***Status***	***Semester***	***Number of ECTS credits***	***Number of lecture hours***
SE&SD-204	***Optional***	***II***	***6***	***30***

Curriculum of IZIIS' Postgraduate Studies

Structural Engineering & Seismic Design Major (Curriculum – 1)

Enrollment conditions:

Name and surname of professors (participants in preparation of contents)):

Principal lecturer: **Assist. Prof. Dr. Roberta Apostolska**
Other lecturers: **Assoc. Prof. Dr. Veronika Sendova**
Visiting professors:

Contents of the subject:

Steel structures:
Characteristic of steel as construction material; design philosophy and formats; classification of cross-sections. Tensile elements; compressed elements; flexural elements; combined bending; axial load and torsion; frames; joints; plastic hinges; secondary problems in design.

Masonry structures:
Introduction: (masonry as the oldest building material); principles of architectural and structural concepts of building configuration: building configuration, dimensions, height, number of stories, distribution of walls; masonry materials and structural systems: masonry units, mortars, concrete infill, reinforcing steel, plain, confined and reinforced masonry; seismic design assumptions and procedures: basic principles of design and analysis of masonry structures, analysis and design of structural walls; foundations, floor structures, ties and roofs. Nonstructural elements.

Timber structures:
Introduction: characteristics of timber as a building material. Design (design of tensile elements, columns, design for combined load, design of joints). Substructures (trusses and wall diaphragms); serviceability period.

Method:

Lectures	*Exercises*	*Numerical and Graphical tasks*	*Use of software*	*Laboratory exercises*	*Seminar papers*	*Field lectures*
Yes	*Yes*	*/*	*Yes*	*/*	*Yes*	*/*

Grading:

Attendance of lectures	*Obligatory tasks*	*Colloquia*	*Seminar papers*	*Written examination*	*Oral examination*
10%	*/*	*/*	*20%*	*30%*	*40%*

References: *Main: Design of Steel for Structures, Structural Engineering Handbook, E. M. Lui, Design and Construction of Stone and Brick Masonry Buildings, Balkan Conference, Timber Structures, Structural Engineering Handbook, J. F. Kennet, Eurocode 3: Design of Steel Structures, Part 1-1: General Rules for Buildings, Part 1-8, Design of Joints, Eurocode 5, Design of Timber Structures, Part 1-1, General – General Rules for Buildings, Eurocode 6: Design of Masonry Structures. Part 2 – Design, Selection of Materials and Construction of Masonry.*

Additional: *Instructive materials prepared by IZIIS' professors in the subject.*

	Subject:	PRESTRESSED AND PRECAST CONCRETE STRUCTURES		
Code	***Status***	***Semester***	***Number of ECTS credits***	***Number of lecture hours***
SE&SD-205	***Optional***	***II***	***6***	***30***

Curriculum of IZIIS' Postgraduate Studies

Structural Engineering & Seismic Design Major (Curriculum – 1)

Enrollment conditions:

Name and surname of professors (participants in preparation of contents)):

Principal lecturer: Prof. Dr. Zivko Bozinovski
Other lecturers:
Visiting professors:

Contents of the subject:

Prestressed structures

Introduction; ways of prestressing; losses during prestressing; materials; computation of prestressed concrete structures; statically indeterminated systems; friction effects; computation according to ultimate state of bearing capacity; partially prestressed concrete; behaviour of prestressed structures under the effect of cyclic loads; use of prestressed concrete in seismically active regions; example.

Precast structures

Introduction; review and analysis of more important analytical and experimental investigations of large panel systems; proportioning of elements of precast RC large panel systems; analysis of vertical wall panels up to ultimate states of strength, rigidity and deformability; nonlinear dynamic response of prefabricated reinforced concrete large panel systems exposed to dynamic – seismic effects; design procedure for analysis of stable and economical precast reinforced concrete large panel systems in seismically active regions; example.

Method:

Lectures	*Exercises*	*Numerical and Graphical tasks*	*Use of software*	*Laboratory exercises*	*Seminar papers*	*Field lectures*
Yes	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*

Grading:

Attendance of lectures	*Obligatory tasks*	*Colloquia*	*Seminar papers*	*Written examination*	*Oral examination*
Yes	*Yes*	*/*	*Yes*	*Yes*	*Yes*

References: *Main: Materials recommended by lecturers in the subject*
Additional: *Selected scientific papers*

	Subject:	BRIDGES, TRANSPORTATION AND INFRASTRUCTURE SYSTEMS		
Code	**Status**	**Semester**	**Number of ECTS credits**	**Number of lecture hours**
SE&SD-206				

Curriculum of IZIIS' Postgraduate Studies

Structural Engineering & Seismic Design Major (Curriculum – 1)

Enrollment conditions:

Name and surname of professors (participants in preparation of contents)):

Principal lecturer: **Prof. Dr. Danilo Ristic**
Other lecturers: **Assoc. Prof. Dr. Vlado Micov**
Visiting professors:

Contents of the subject:

Fundamentals of design of bridge structures: conceptual design (preliminary and final design); bridge loads and distribution of loads, load combinations; history of advanced analysis and modeling of bridge structures; recent experimental studies of bridge components. Superstructure design for reinforced concrete bridges; prestressed concrete bridges, suspended bridges; cable-stayed bridges; stone and timber bridges; movable bridges; floating bridges; railroad bridges; expansion joints. Innovative design; advanced modeling and analysis procedures. Substructure design: design of bridge bearings, bridge piers and columns, bridge towers, pier-beam connections, pier–footing design, abutments and retaining structures. Geotechnical surveys, shallow foundation, deep foundation; construction and maintenance of bridges. Expert analysis of bridges: classification of bridges, general design guidelines, section capacity analysis, formulation of recent mathematical models for analysis of integral bridges. Repair and strengthening of bridges; bridge information system, damage identification, prioritization methods, repair and strengthening criteria, diagnosis of conditions of structures for revitalization. Monitoring of conditions of structures, testing of foundation soil, seismic instrumentation of bridges, maintenance of bridges.
Design of transportation systems and lifelines. Design parameters, soil instability (landslides, rockfalls, etc.). Damage assessment, effects from exploitation, failure of soil along alignments and specific structural systems, classification of damage and damage potential. Water supply systems, gas pipelines, power supply systems, telecommunication systems, transportation systems, waste disposal systems, design of specific structures, pipelines, underground structures; code requirements.

Method:

Lectures	*Exercises*	*Numerical and Graphical tasks*	*Use of software*	*Laboratory exercises*	*Seminar papers*	*Field lectures*
Yes	*Yes*	*Yes*	*Yes*	*/*	*Yes*	*/*

Grading:

Attendance of lectures	*Obligatory tasks*	*Colloquia*	*Seminar papers*	*Written examination*	*Oral examination*
Yes	*Yes*	*/*	*Yes*	*/*	*Yes*

References: *Main: Materials recommended by the lecturers in the subject.*
Additional: *Selected scientific papers*

	Subject: DAMS AND SPECIAL STRUCTURES			
Code	***Status***	***Semester***	***Number of ECTS credits***	***Number of lecture hours***
SE&SD-207	***Optional***	***II***	***6***	***30***

Curriculum of IZIIS' Postgraduate Studies

Structural Engineering & Seismic Design Major (Curriculum – 1)

Enrollment conditions:

Name and surname of professors (participants in preparation of contents)):

Principal lecturer: **Assoc. Prof. Dr. Violeta Mircevska**
Other lecturers: **Prof. Dr. Mihail Garevski**
Visiting professors:

Contents of the subject:

1. Seismic design of gravity and arch dams. Seismic behavior of dams and types of damages due to occurred earthquakes. Definition of main and additional loads due to seismic effect, hydrodynamic pressure and inertial forces. Mathematical modeling by including dam-soil-reservoir interaction, concepts and methods of analysis. Definition of main parameters of the mathematical model, mass stiffness, damping. Analysis of discontinuities, i.e., structural and perimeter expansion joints. Definition of parameters of contact elements. Field tests and analysis of natural vibrations. Linear and nonlinear stress-strain state. Stability criteria. Instructions for improvement of seismic safety in dam design.

2. Seismic design of dams constructed of local materials. Seismic behavior of dams exposed to earthquakes. Comments on statistic data on typical damage due to occurred earthquakes. Mathematical modeling by application of linear and nonlinear mathematical models. Effect of variation of pore pressure upon dam stability. Dynamic response of dams. Characteristics of natural vibrations, effect of the geomechanical characteristics of the present materials upon dynamic response. Effect of dam-reservoir-foundation interaction. Effect of dam geometry upon stress-strain state. Stability criteria. Instructions for improvement of seismic stability of dams.

3. Special attention is paid to mathematical modeling of 2D and 3D models by application of finite elements, boundary elements and contact elements. Application of computer programmes in dam analysis.

4. Seismic behaviour of special structures and types of damage due to occurred earthquakes. Analysis of seismic behaviour of special structures exposed to earthquakes.

Method:

Lectures	*Exercises*	*Numerical and Graphical tasks*	*Use of software*	*Laboratory exercises*	*Seminar papers*	*Field lectures*
Yes	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*No*

Grading:

Attendance of lectures	*Obligatory tasks*	*Colloquia*	*Seminar papers*	*Written examination*	*Oral examination*
5%	*%%*		*30%*	*30%*	*30%*

References: *Main: Dam Engineering, Volumes 1, 2 and 3, Hinds and Geger and Justine*
Additional: *ICOLD reports*

	Subject:	MANAGEMENT OF URBAN CATASTROPHES AND STRATEGIC PLANNING		
Code	***Status***	***Semester***	***Number of ECTS credits***	***Number of lecture hours***
SE&SD-208	***Optional***	***II***	***6***	***30***

Curriculum of IZIIS' Postgraduate Studies

Structural Engineering & Seismic Design Major (Curriculum – 1)

Enrollment conditions:

Name and surname of professors (participants in preparation of contents)):

Principal lecturer: **Prof. Dr. Zoran Milutinovic**
Other lecturers: **Assist. Prof. Dr. Goran Trendafiloski**
Visiting professors:

Contents of the subject:

Contemporary natural and man-made disasters: socio-economic and political significance of disasters: traditional and new threats, geography of disasters, modern loss factors. The most important aspects. Disaster threat and general effects. Outlines of individual disasters, process of defining the disaster threat and use of information on disaster threat. Causal factors of disasters: poverty, population growth, urbanization, degradation of environment. Lack of awareness and information. Wars and civil unrests. Phases of disaster: disasters with fast and slow genesis. Characteristics of individual hazards and disasters: earthquakes, tsunamis, tropical cyclones, floods, droughts, environmental pollution, deforestation, epidemics, chemical and industrial accidents. Importance of disasters: research and evaluation, warning and warning systems, preparedness plans, format, process and critical spheres of management.

Planning, economic and societal aspects of management of disaster risks: earthquake disaster management: planning for mitigation of seismic risk, strategies for managing earthquake losses, reduction of earthquake consequences. Main aspects of urban disaster management: disasters and national development, legislation, disaster management cycle, main activities, resources, international aid, leadership, organization, planning, utilization of resources. Long term measures: prevention, mitigation, preparedness, response, logistics. Major factors of post disaster impact, post-disaster recovery, post-disaster balance, support to disaster management, training, public awareness. UN programmes for mitigation of disaster consequences: International Decade (IDNDR), International Strategy (ISDR), Yokohama Strategy and Huogo Framework Document.

GIS technology for disaster and emergency management: Introduction, current state-of-the-art, data inventory, data attributing and matching, development and structuring of layers, analysis, thematic mapping, generation of results, decision making; traditional versus dynamic decision support systems, new technologies for monitoring and disaster risk management.

Method:

Lectures	*Exercises*	*Numerical and Graphical tasks*	*Use of software*	*Laboratory exercises*	*Seminar papers*	*Field lectures*
70%	*/*	*/*	*/*	*/*	*30%*	*/*

Grading:

Attendance of lectures	*Obligatory tasks*	*Colloquia*	*Seminar papers*	*Written examination*	*Oral examination*
Yes	*Yes*	*/*	*Yes*	*Yes*	*Yes*

References: *Main: Mimeographed notes for DAAD master studies prepared by Prof. Dr. Z. Milutinovic*
Additional: *Selected papers*

	Subject:	DESIGN BY APPLICATION OF EUROCODE 8		
Code	***Status***	***Semester***	***Number of ECTS credits***	***Number of lecture hours***
SE&SD-209	***Optional***	***II***	***6***	***30***

Curriculum of IZIIS' Postgraduate Studies

Structural Engineering & Seismic Design Major (Curriculum – 1)

Enrollment conditions:

Name and surname of professors (participants in preparation of contents)):

Principal lecturer: **Prof. Dr. Mihail Garevski**
Other lecturers: **Prof. Dr. Golubka N. Cvetanovska**
Prof. Dr. Danilo Ristic
Prof. Dr. Zoran Milutinovic
Visiting professors:

Contents of the subject:

Main concept of design of structures by application of EUROCODE 8

1. Principles and design rules;
2. Fundamental requrements and structural „performance“ requirements;
3. Soil conditions and seismic effects;
4. Design of seismically resistant buildings (main principles, analysis of structures, verification of seismic safety);
5. Specific requirements (regulations) for reinforced-concrete buildings (definitions, design concepts, design rules for specific elements and details);
6. Specific requirements for steel buildings (definitions, design concepts, specific design rules for different structural elements and details);
7. Specific requirements for composite structures constructed of steel and concrete (definitions, specific design requirements for different structural elements and structural details);
8. Specific requirements for timber structures (main requirements and design rules);
9. Specific requirements for masonry structures (main requirements and design rules);
10. Base isolation of structures (definitions and specific design requirements);
11. Practical recommendations for application of Eurocode 8 in design practice.

Method:

Lectures	*Exercises*	*Numerical and Graphical tasks*	*Use of software*	*Laboratory exercises*	*Seminar papers*	*Field lectures*
Yes	*/*	*/*	*yes*	*/*	*Yes*	*/*

Grading:

Attendance of lectures	*Obligatory tasks*	*Colloquia*	*Seminar papers*	*Written examination*	*Oral examination*
5%	*30%*	*/*	*/*	*50%*	*15%*

References: *Main: Materials recommended by the lecturers in the subject*
Additional: *Selected scientific papers*