“Ss Cyril and Methodius” University

Institute of Earthquake Engineering and Engineering Seismology, Skopje

POST-GRADUATE (MASTER) STUDIES IN THE FIELD OF EARTHQUAKE ENGINEERING

Program 1: Structural Engineering and Seismic Design

Program 2: Earthquake Engineering

Proposed by: Institute of Earthquake Engineering and Engineering Seismology - IZIIS, Skopje

Director,

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Skopje, 2010

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BACKGROUND OF THE MODIFICATIONS AND AMENDMENTS OF THE IZIIS' EDUCATION CURRICULA

As a internationally very active member of the "Ss. Cyril and Methodius" University – Skopje in the scientific fields related to development and enhancement of modern technology for control and mitigation of seismic risk through improvement of structural systems of engineering structures, IZIIS has continuously been committed to education of staff from the home country and abroad for the highest academic degree of master and doctor of technical sciences already for 40 years, i.e., since 1965.

Today, the Institute of Earthquake Engineering and Engineering Seismology (ZIIS) can rightfully be proud of the fact that the first post-graduate studies leading to the master degree in Republic of Macedonia, i.e., at the "Ss. Cyril and Methodius" University were successfully organized and realized by this institute.

Today, IZIIS represents an internationally highly reputed scientific institution that continuously and successfully educates scientific staff to the degree of master and doctor of technical sciences in the field of earthquake engineering, which is a specific and multi-disciplinary scientific field integrating a long series of other scientific disciplines as are structural engineering with static and seismic design, engineering seismology, static and seismic design of high-rises, static and seismic design of engineering structures, specific seismic problems in geotechnics, ecology in seismic regions and alike.

The IZIIS' educational activity has so far successfully and thoroughly covered the stated related and specific scientific disciplines integrated into a wider modern and up-to-date interdisciplinary scientific field defined as earthquake engineering.

However, the acceptance of the Bologna Declaration by Republic of Macedonia also imposed the need for adequate harmonization of the IZIIS' curricula.

These were the reasons for the preparation of the modifications and amendments of syllabi for Post-graduate (master) Studies.

In fact, the New IZIIS Education Curricula is presently officially offered by the Institute of Earthquake Engineering and Engineering Seismology, Ss. Cyril and Methodius University, Skopje, enabling the following:

1. Introducing of the European Credit Transfer System (ECTS) in the educational program of IZIIS;

2. Complete compliance of the curricula with the provisions contained in the Bologna Declaration;
3. Harmonization of the curricula with the modern needs for education of staff to the highest academic degrees in the scientific field that IZIIS has been dealing with permanently and very successfully for a long period of its existence (more than 40 years); and,
4. Providing of more adequate and optimized conditions for successful internationalization of the modern educational activity of IZIIS using all the technical-technological and other advantages of the modern times.

In fact, the New IZIIS' education curricula will enable fulfillment of the main goals set out by "Ss. Cyril and Methodius" University, Skopje that are of interest for both the University and IZIIS.

The present New IZIIS Education Curricula is based on the actual needs in modern civil engineering, particularly in seismically active regions where the interest in structural engineering, earthquake engineering, engineering seismology and related scientific fields is increasing.

1. OBJECTIVES OF THE IZIIS' MASTER STUDIES

The study of the recent scientific achievements in the field of modern civil engineering and particularly structural engineering and earthquake engineering with engineering seismology as key disciplines represents the main prerequisite for adequate practical improvement and permanent development of several main and/or essential industrial sectors.

Almost all the countries in Southeast Europe and a large number of countries in Europe and worldwide are located in seismically active regions that, with their permanent and high seismic activity, represent the most serious source of heavy natural catastrophes.

The moment of occurrence of earthquakes can still not be predicted, but due to the increasing urbanization of a large number of regions worldwide, the earthquakes represent today the most serious and the largest natural catastrophes. The annual average loss of human lives amounted to several tens of thousands according to the existing statistic data from the XX century. In most of the cases, the extraordinarily huge losses of material property have caused heavy economic and social impact on entire countries and regions.

From the stated reasons, in all the seismically vulnerable countries and regions in Europe and the World, it is necessary to undertake urgent and adequate measures for the purpose of minimizing the consequences of seismic effects in future. One of the most effective approaches is undertaking of national scientifically based integral technical and organizational measures for minimizing of both direct and indirect losses due to future earthquakes.

To successfully effectuate the integral national strategy for minimization of earthquake consequences, the first, i.e., the main step is education of staff through organization of post-graduate master studies in specific fields as are modern structural and earthquake engineering, engineering seismology, geotechnical engineering, ecology and alike.

Due to the stated reasons, the post-graduate master studies that enable continuous training of corresponding necessary staff and experts are of an extraordinary importance and are socially and economically justified. In addition to their contribution to the advancement of the civil engineering in general, they will also continuously contribute to the development of the technology for minimization of earthquake catastrophes in future in both our country and beyond, in the seismically active regions in Europe and the World.

Therefore, the main purpose of the post-graduate master studies held at IZIIS is permanent education of adequate staff in the specific scientific fields not only in our country but also the other neighbouring and European countries as well as countries beyond. These wide international achievements will be realized through international exchange of students and involving own and world renowned experts in the process of permanent education. Through acceptance of foreign students and establishment of distributed post-graduate master studies abroad, a wide international positive contribution to the realization of the set out universal educational goals will be achieved. In the course of the same educational process, adequate compatibility of the proposed educative programme with similar programmes that are being realized in the developed countries worldwide (which have widely been accepted in the modern educative, development and applicative practice in the World) will be provided.

2. COVERED SCIENTIFIC FIELDS AND ACADEMIC TITLES

Generally, the post graduate master studies in R. Macedonia organized by the Institute of Earthquake Engineering and Engineering Seismology, Skopje are dispersed, if necessary, as independent or cooperative studies abroad or as studies for a joint degree in all the specific scientific fields in the domains of seismic construction, earthquake engineering and wider.

According to the curricula, the post-graduate lecturing in this phase will be organized permanently or cyclically in the following fields:

1. Structural engineering and seismic design (Program – 1)

2. Earthquake Engineering (Program – 2)

Upon completion of the master studies in these scientific fields, the candidates will acquire the academic title of:

- *Master of science in the field of Earthquake Engineering*

In future, the post-graduate lecturing process will be expanded in other directions in accordance with the needs of the country and worldwide.

2.1. Program 1: Structural Engineering and Seismic Design

The main purpose of the master studies in structural engineering and seismic design is to enable education of candidates in the domain of structural engineering in the field of civil engineering including study of recent methods of analysis, design and evaluation of structural systems exposed to the effect of general traditional and seismic loads as well as other specific

types of static and dynamic loads. The studies are modulated in such a way that they cover a wide spectrum of specific disciplines in the field of structural engineering and seismic design. The programme enables coverage of structures of the type of buildings of different structural systems (reinforced concrete, steel, masonry, mixed etc.) as well as a large number of complex engineering structures of different categories (bridges, dams, special structures, infrastructure systems etc.). The programme involves lectures in the field of the most recent general numerical methods for analysis, expertise and design of structures as well as adequate basic education in the field of modern earthquake engineering.

The main educational goals of the master studies in the field of structural engineering are the following:

Production of professional experts capable of continuing their successful professional career in modern industry;

- Production of creative staff that will be able to continue their high education up to the academic title of doctor of technical sciences;
- Qualifying of candidates for creative and development-oriented design activities in the field of structural engineering and seismic design;
- Qualifying of candidates for performance of complex tasks in the field of design and technological improvement of stability and safety of different types of structural systems.

The programme of the post-graduate master studies in the field of structural engineering and seismic design that has been harmonized with the European Credit Transfer System (ECTS) is given in the corresponding tables (1a, 1b and 1c) shown in Appendix B1 (tables with a list of obligatory and optional subjects per semesters).

2.2. Program 2: Earthquake Engineering

The main purpose of the master studies in earthquake engineering is to enable education of candidates in the domain of modern earthquake engineering. The candidates are qualified to apply the latest methods of design and construction of seismically safe structures. The studies are modulated such that they involve a wide spectrum of engineering structures of the type of buildings (reinforced concrete, steel, masonry buildings and alike) as well as complex engineering structures: bridges, dams, infrastructure systems, special structures and alike. The program includes lectures in the field of modern earthquake engineering with a special emphasis on modern theoretical concepts and numerical methods for seismic analysis and design of seismically safe structures.

The main educational goals of the master studies in the field of earthquake engineering are the following:

1. Production of professional experts in earthquake engineering capable of continuing their successful professional career in industry, public sector or nongovernmental organizations;
2. Production of creative staff in the field of earthquake engineering that will be capable of continuing their high education to the acquiring of the academic degree of doctor of technical sciences;
3. Qualification of candidates for creative and developmental design activity in the earthquake engineering field;
4. Qualification of candidates in realization of complex tasks in the field of design and improvement of the seismic stability and safety of different types of structural systems.

The program of the postgraduate master studies in the field of earthquake engineering that has been harmonized with the European Credit Transfer System (ECTS) is given in tables 2a, 2b and 2c shown in Appendix B2 (tables containing the list of obligatory and optional subjects).

3. TIME DURATION OF THE STUDIES

To enable successful harmonization of the time duration of the post graduate master studies organized by IZIIS with the education criteria contained in the Bologna Declaration, it is anticipated that the master studies last three semesters.

The first two semesters are anticipated for attendance and passing of examinations in the anticipated subjects (obligatory and optional), whereas the last (the third) semester is anticipated for elaboration of an independent master thesis in accordance with the previously selected topic.

4. ENROLLMENT CONDITIONS

Candidates to be enrolled in the post graduate master studies should fulfill the following conditions:

- They should have a completed corresponding degree of previous professional training (high education) and should fulfill the other conditions defined in the announced competition;

- Appropriate degree of previous professional training is considered completed high education with duration of three to five years, i.e., acquired academic title of “Bachelor”, i.e., the candidate should have 240 equivalent credits acquired through previous education;
- If the candidate has less credits from the candidate’s previous study for Bachelor degree, it is necessary that the candidate passes examinations per additional subjects in order to achieve a sufficient number of credits according to the recommendation given by the IZIIS’ Commission for Post-graduate Master and Doctoral Studies (as a body responsible for education) through a resolution made by the Academic Council;
- If the candidate has achieved more than the prescribed credits, the candidate could be exempted from passing certain subjects or corresponding parts of subjects upon the candidate’s request and according to the same procedure (resolution made by the Scientific Council upon recommendation given by the Commission for Master and Doctoral Studies);
- Due to the differences in previous education of candidates coming from different faculties from the home country and abroad, the necessary conditions for enrollment of each candidate are evaluated and defined by the IZIIS’ Commission for Post-graduate Master and Doctoral Studies responsible for education.

5. SELECTION AND ACCEPTANCE OF CANDIDATES

In accordance with the above conditions, selection of candidates is done and confirmed by an official resolution made by the IZIIS’ Scientific Council within 20 days from the date of expiry of the term for application. The IZIIS’ Scientific Council makes decisions about enrollment of each additionally applied candidate.

The candidates are informed in writing about being selected and accepted for the studies. At the same time, each candidate is individually informed about the specific conditions under which the candidate has been enrolled in the IZIIS’ master studies.

The information contains the following clarifications:

- whether the candidate has been accepted directly without any other conditions;
- whether the candidate should pass additional examinations in order to obtain a sufficient number of additional equivalent credits; and

- whether the candidate has more credits than necessary and could therefore be exempted from passing of certain subjects or parts of subjects.

The candidates could come from Republic of Macedonia, Southeast Europe, developing countries as well as developed countries from Europe and the World. The candidates could also be involved in organized joint studies with other high education institutions from the home country and abroad if IZIIS participates in the realization of such studies (for example: joint degree studies).

6. SELECTION OF TOPIC, MENTOR AND DEFENSE OF MASTER THESIS

For each enrolled candidate, the Scientific Council of IZIIS makes a resolution by which it appoints mentor and accepts theme of the master thesis. The candidate first submits to the IZIIS' Scientific Council a request with a proposed theme and possible proposal for appointment of a supervisor. The proposal is considered by the Commission for Post-graduate and Doctoral Studies from the aspect of the current interest in the subject and in line with the originality principle.

Following the harmonization of the proposal in cooperation with the candidate, the IZIIS' Scientific Council makes a resolution on acceptance of the theme and appointed mentor of the master thesis.

As a rule, the selection of themes and appointment of mentors of master theses is done in the beginning of the third semester, i.e., earlier, if the candidate has acquired at least 80% of the anticipated credits. If the candidate legs behind with the passing of the examinations, the theme and the mentor of the master thesis are defined as soon as the candidate passes at least 80% of the anticipated subjects.

As a rule, the candidate elaborates the master thesis in the course of the third semester. The candidate submits five copies of the elaborated master thesis to IZIIS. With a resolution, the IZIIS' Scientific Council appoints a Reviewing Commission composed of at least 3 members and President of the Commission.

The Reviewing Commission submits a reviewing report to be adopted by the Scientific Council of IZIIS. After adopting the reviewing report, the Scientific Council appoints Commission for Public Defense of the master thesis composed of at least 3 members and specifies the time of the public defense.

The candidate defends the master thesis in public before the Commission at the specified time, in line with the prescribed procedure for public defense of master theses.

Using modern technical tools, the candidate may defend the master thesis in public through an organized video conference or other technique that enables proving the candidate's knowledge of the elaborated master thesis.

After the successful defense of the master thesis, the Commission signs a decision and confers the title of Master of Technical Sciences upon the candidate.

7. REALIZATION OF THE TEACHING PROCESS

Depending on the number and the composition of applied candidates, the educational process can be carried out in three ways as follows:

1. through group lectures in a classroom;
2. through individual teaching or mentorship, and
3. through other modern type of distance learning as are video conferences, Internet and alike.

The decision on the mode of performance of the educational process is made by the Scientific Council of IZIIS.

The curriculum of each subject shows the contents that are elaborated and studied through lectures, literature, exercises, seminar papers and alike.

The subjects of the post-graduate master studies are attended and passed in the course of the first two semesters. Generally, the anticipated subjects per majors are divided into two groups which are the following:

1. Obligatory subjects (Group-1)
2. Optional subjects (Group-2)

Upon successful termination of the lecturing process anticipated for the first semester (acquired signatures), the candidate is entitled to pass the anticipated obligatory and optional subjects from the first semester.

Generally, the teaching process is anticipated to be flexible with the main purpose of enabling of as successful as possible transfer of the necessary knowledge. Particular attention is paid to the present actual needs arising from the globalization of education as well as the actual conditions and potentials of different regions in the world for the purpose of assisting the candidates to the best possible extent in realizing their high education for the degree of master of technical science as successfully as possible.

8. CURRICULA

The curriculum of each scientific field (major) in which the post-graduate master studies are organized at IZIIS is defined separately, respecting the basic principle of duration of the studies to a total of 3 semestres and the condition that the necessary number of credits acquired by the candidate through passing the examinations be at least 60, in line with the European Credit Transfer System (ECTS).

The final curriculum for each scientific field in which IZIIS organizes post-graduate master studies is defined by the IZIIS' Academic Council.

For each major of master studies organized by IZIIS, the curricula per subjects and contents have been harmonized with the European Credit Transfer System (ECTS).

9. NECESSARY NUMBER OF CREDITS

The student (the candidate) of the IZIIS' post-graduate master studies leading to the academic degree of master of technical sciences must sign on and pass all the obligatory subjects anticipated with the curriculum and a certain number of optional subjects in order to acquire a total amount of minimum 60 credits from passed examinations.

In addition to the condition given above, the student should apply for, elaborate and publicly defend a master thesis in accordance with the IZIIS' procedure for elaboration and public defense of master theses.

With the elaboration and public defense of the master thesis, the candidate acquires additional 30 credits.

In accordance with the above presented criteria, in order to acquire the academic degree of master of sciences, the student must acquire a total amount of at least 90 credits.

10. ENROLLMENT IN SUBSEQUENT SEMESTRES

The candidate is enrolled in a subsequent semester based on:

1. Certified previous semester;

2. Paid tuition fee for the next semester (if financing or co-financing of the candidate's enrollment in post-graduate lecturing process is not solved otherwise)

Certain non-passed or non-certified subjects from the previous semester are not a hindrance for enrollment in the next semester.

The condition for enrollment of candidates in the first semester at IZIIS is:

1. To be accepted for post-graduate master studies at IZIIS, the candidate should have an acquired sufficient number of credits (at least 240) from the candidate's previous education;
2. The candidate should fulfill the other conditions prescribed with the competition;
3. The candidate should pay the tuition fee anticipated for the organization of the lecturing process in the course of the first semester for the concrete academic year.

The conditions for enrollment of the candidates in the third (the last) semester of master studies at IZIIS are;

1. Certified previous semester;
2. Paid tuition fee for organization of the activities anticipated for the third semester, elaboration of the master thesis under the supervision of the mentor and public defense of the master thesis.

The amount of the tuition fee for each semester of studies at IZIIS is defined by the Scientific Council through a resolution made by the IZIIS' Council.

11. TITLE TO TAKING EXAMINATIONS

The candidate is entitled to take an examination per individual subject provided that the candidate has fulfilled the following conditions:

1. The candidate has to have the signature of the lecturer in the subject in his student's booklet;
2. The candidate has to have all the obligations referring to that subject fulfilled;
3. The candidate has to have all the examinations anticipated for the previous semester passed.

The lecturer in the subject may relax the condition stated under item 3 of the previous paragraph in case the non-passed examinations do not greatly affect the mastering of the curriculum of the lecturer's subject.

12. CONDITIONS FOR TAKING EXAMINATIONS

The student has the right to take examination in each subject three times at the most. In case of failure, the student loses the right to further study and enrollment in semester.

The student can renew the right to post-graduate studies at IZIIS by enrollment in the post-graduate studies again through a resolution made by the IZIIS' Academic Council.

13. MODE OF TAKING EXAMINATIONS

Examinations at the IZIIS' master studies are taken before the lecturer in the corresponding subject in one of the following ways:

- Written examination only;
- Oral examination in combination with a written concept of the response;
- Combined examination (written, oral, elaboration of seminar paper and alike).

The success achieved at the examinations is evaluated by grades ranging from 5 (negative grade) to 10 (the highest positive grade). The final grade is established in line with the conditions from the curriculum referring to the particular subject.

14. COMPLAINT TO ACQUIRED GRADE

If the student is not satisfied with the mode of taking the examination or the grade obtained, he has the right to lodge a complaint to the IZIIS' Scientific Council within seven (7) days. If the complaint is justified, the Scientific Council shall establish a Commission for the taking of the exam.

15. TERMS OF STUDY

The students of IZIIS' master studies shall pass the examinations anticipated with the curricula within two (2) years from the time they have acquired the right to passing the examinations, i.e., from the time of termination of the lectures in the corresponding subject.

Upon submittal of a student's request providing a corresponding rationale, the IZIIS' Scientific Council may extend the term for passing of an exam.

16. ACQUIRING ACADEMIC DEGREE OF MASTER OF SCIENCES

The academic degree of master of technical sciences in the corresponding scientific field at IZIIS is conferred to a student through accomplishment of a certain curriculum whose contents are validated by credits, including the elaborated master thesis.

The curricula of the postgraduate master studies are accomplished with a total of 90 acquired credits (60 credits from passing of the obligatory and optional subjects and 30 credits from the elaborated and publicly defended master thesis).

The master thesis is the result of an independent work of the student by which the student proves that the student has mastered an adequate fund of scientific knowledge and has contributed to gaining of new scientific knowledge.

The candidate elaborates the master thesis under the supervision of the candidate's previously appointed mentor.

The mode and the procedure of public defense of the master thesis are carried out according to a defined procedure.

17. MASTER STUDIES IN INTERNATIONAL FRAMES

The master studies at IZIIS have a long tradition of over 40 years. The lecturing process within these studies is continuously carried out in English language. Having in mind the originally established very high basic criteria, the master studies at IZIIS have a long tradition and are highly respected in all the countries worldwide.

The realized long term and permanent international tradition of the master studies has widely contributed to the reputation of IZIIS. The candidates, who have accomplished master studies at IZIIS have widely been accepted in the world in realizing their next step of education for the degree of doctor of technical sciences.

Having in mind the long international tradition of the master studies at IZIIS. education of candidates from all interested countries in the region, Europe and the World is anticipated for the next period.

18. FINANCING OF THE MASTER STUDIES

The education for the academic degree of master of technical sciences in a specified scientific field is financed, in principle, in a number of ways for concrete candidates. These are the following:

1. Total or partial financing of successful candidates directly by governments or governmental institutions of interested countries;
2. International fellowships from different sources awarded to successful candidates;
3. Financing of individual candidates by the industry, for the needs of concrete companies.
4. Financing of candidates from available European and world funds (through different prescribed instruments and programs);
5. Self-financing of interested candidates from different regions and countries from Europe and worldwide.

The amount of the financial resources for attendance and accomplishment of the master studies at IZIIS is defined based on a resolution made by the IZIIS' Council for each concrete academic year. Generally, IZIIS is interested in accepting students from all the

continents. Starting with this main principle, the necessary financial resources have been optimized and reduced to a realistic level for the purpose of enabling enrollment of students from as greater number of world countries of different economic development as possible.

Appendix – A:

LIST OF PROFESSORS, ASSOCIATE PROFESSORS, ASSISTANT PROFESSORS AND SCIENTIFIC COLLABORATORS – LECTURERS AT THE POST GRADUATE (MASTER STUDIES AT IZIIS

Appendix - B1:

REVIEW OF CURRICULUM:
LIST OF OBLIGATORY AND OPTIONAL SUBJECTS OF THE IZIIS' MASTER STUDIES IN STRUCTURAL ENGINEERING AND SEISMIC DESIGN (Programme-1)

Appendix - B2:

REVIEW OF CURRICULUM:
LIST OF OBLIGATORY AND OPTIONAL SUBJECTS OF THE IZIIS MASTER STUDIES IN EARTHQUAKE ENGINEERING (Programme-2)

Appendix - C1:

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

Appendix - C2:

DESCRIPTION OF CURRICULUM PER OBLIGATORY AND OPTIONAL SUBJECTS WITHIN THE IZIIS' MASTER STUDIES IN EARTHQUAKE ENGINEERING (Programme-2)

Appendix – A:

LIST OF PROFESSORS, ASSOCIATE PROFESSORS, ASSISTANT PROFESSORS AND SCIENTIFIC COLLABORATORS – LECTURERS AT THE POST GRADUATE (MASTER) STUDIES AT IZIIS

Appendix – A: LIST OF PROFESSORS, ASSOCIATE PROFESSORS, ASSISTANT PROFESSORS AND SCIENTIFIC COLLABORATORS – LECTURERS AT THE POST GRADUATE (MASTER), DOCTORAL AND POST-DOCTORAL STUDIES AT PUBLIC SCIENTIFIC INSTITUTE - IZIIS

1. FULL TIME PROFESSORS

1. **Prof. Dr. Mihail GAREVSKI**

   Wider lecturing-scientific field: earthquake engineering, structural engineering, engineering structures and geotechnics. Lecturing subject since the last election: Seismic Design of Special Structures.

2. **Prof. Dr. Golubka NECEVSKA-CVETANOVSKA**

   Wider lecturing-scientific field: earthquake engineering, structural engineering, highrises, seismic design. Lecturing subject since the last election: Seismic Design of RC, Steel and Masonry Structures.

3. **Prof. Dr. Danilo RISTIC**

   Wider lecturing-scientific field: earthquake engineering, structural engineering, engineering structures and geotechnics. Lecturing subjects since the last election: Analysis of Structures; Planning and Design of Transportation Systems and Other Infrastructure Systems in Seismic Areas.

4. **Prof. Dr. Zoran MILUTINOVIC**

   Wider lecturing-scientific field: earthquake engineering, engineering seismology, analysis of vulnerability and management of catastrophes. Lecturing subjects since the last election: Seismic Risk and Vulnerability Analysis; Engineering Seismology.

5. **Prof. Dr. Ljubomir TASKOV**

   Wider lecturing-scientific field: earthquake engineering, structural engineering, experimental mechanics. Lecturing subject since the last election: Dynamics of Structures.

6. **Prof. Dr. Zivko BOZINOVSKI**

   Wider lecturing-scientific field: earthquake engineering, structural engineering, highrises. Lecturing subject since the last election: Repair and Strengthening of Structures.

7. Prof. Dr. Snezana STAMATOVSKA

Wider lecturing-scientific field: earthquake engineering, engineering seismology, reliability of structures. Lecturing subjects since the last election: Reliability of Structures.

8. Prof. Dr. Veronika SENDOVA

Wider lecturing-scientific field: earthquake engineering, structural engineering, highrises, engineering materials. Lecturing subject since the last election: Engineering Materials.

9. Prof. Dr. Viktor HRISTOVSKI

Wider lecturing-scientific field: earthquake engineering, structural engineering, engineering structures and geotechnics. Lecturing subject since the last election: Finite Element Analysis.

10. Prof. Dr. Vlado MICOV

Wider lecturing-scientific field: earthquake engineering, structural engineering, engineering structures and geotechnics. Lecturing subject since the last election: Planning and Design of Transportation Systems and Other Infrastructure Systems in Seismically Prone Areas.

II. ASSOCIATE PROFESSORS

11. Assoc. Prof. Dr. Zoran RAKICEVIC

Wider lecturing-scientific field: earthquake engineering, structural engineering, experimental mechanics, control of structures. Lecturing subject since the last election: Controlled Behaviour of Structures.

12. Assoc. Prof. Dr. Lidija KRSTEVSKA

Wider lecturing-scientific field: earthquake engineering, structural engineering, experimental mechanics. Lecturing subject since the last election: Experimental Mechanics.

13. Assoc. Prof. Dr. Roberta PETRUSEVSKA

Wider lecturing-scientific field: earthquake engineering, structural engineering, highrises, seismic design. Lecturing subject since the last election: Seismic Design of RC, Steel and Masonry Structures.

14. Assoc. Prof. Dr. Violeta MIRCEVSKA

Wider lecturing-scientific field: earthquake engineering, structural engineering, engineering structures and geotechnics. Lecturing subject since the last election: Design of Dams.

15. Assoc. Prof. Dr. Vlatko SESOV

Wider lecturing-scientific field: earthquake engineering, structural engineering, engineering structures and geotechnics. Lecturing subject since the last election: Dynamics of Soil and Foundation.

III. ASSISTANT PROFESSORS

16. Assist. Prof. Dr. Dragi DOJCINOVSKI

Wider lecturing-scientific field: earthquake engineering, engineering seismology. Lecturing subjects since the last election: Engineering Seismology.

VI. SCIENTIFIC COLLABORATORS

17. Dr. Dusko ALEKSOVSKI, senior scientific collaborator

Wider lecturing-scientific field: earthquake engineering, engineering seismology, geophysics.

18. Dr. Biserka DIMISKOVSKA, senior scientific collaborator

Wider lecturing-scientific field: earthquake engineering, engineering seismology, ecology.

19. Dr. Katarina MANOVA, senior scientific collaborator

Wider lecturing-scientific field: engineering seismology, signal processing, computer technology.

20. Dr. Gavril MIRAKOVSKI, senior scientific collaborator

Wider lecturing-scientific field: earthquake engineering, engineering seismology, geophysics.

Appendix - B1:

REVIEW OF CURRICULUM: LIST OF OBLIGATORY AND OPTIONAL SUBJECTS OF THE IZIIS' MASTER STUDIES IN STRUCTURAL ENGINEERING AND SEISMIC DESIGN (Programme-1)

Tab 1a. IZIIS POST-GRADUATE STUDIES IN STRUCTURAL ENGINEERING AND SEISMIC DESIGN (Programme-1)

Tab. 1.a1. SEMESTER I: Obligatory subjects

No.	No. of lecture hours	Subjects	Credits	Lecturers (from IZIIS and invited)
SE&SD-101	30	Dynamics of Structures	6	
SE&SD-102	30	Analysis of Structures	6	
SE&SD-103	30	Building Materials	6	
SE&SD-104	30	General Principles of Design of Structures	6	
Total	**120**		**24**	

Tab 1.a2. SEMESTER I: Optional subjects (to be selected one (1) from the list)

No.	Number of lecture hours	Subjects	Credits	Lecturers (from IZIIS and invited)
SE&SD-105	30	Experimental Mechanics	6	
SE&SD-106	30	Geotechnical Engineering	6	
SE&SD-107	30	Fundamentals of Earthquake Engineering and Engineering Seismology	6	
SE&SD-108	30	Introduction to MATLAB and its application in engineering analyses	6	
Total	**120**		**24**	

Tab 1b. IZIIS POST-GRADUATE STUDIES IN STRUCTURAL ENGINEERING AND SEISMIC DESIGN (Programme-1)

Tab 1.b1. SEMESTER II: Obligatory subjects

No.	Number of lecture hours	Subjects	Credits	Lecturers (from IZIIS and invited)
SE&SD-201	30	Reinforced Concrete Structures	6	
SE&SD-202	30	Application of FEM in Structural Analysis	6	
SE&SD-203	30	Project Planning and Management	6	
Total	**90**		**18**	

Tab 1.b2. SEMESTER II: Optional subjects (to be selected two (2) from the list)

No.	Number of lecture hours	Subjects	Credits	Lecturers (from IZIIS and invited)
SE&SD-204	30	Steel, Masonry and Timber Structures	6	
SE&SD-205	30	Prestressed and Prefabricated Concrete Structures	6	
SE&SD-206	30	Bridges, Transportation and Infrastructure Systems	6	
SE&SD-207	30	Dams and Special Structures	6	
SE&SD-208	30	Management of Urban Catastrophes and Strategic Planning	6	
SE&SD-209	30	Design by Application of EUROCODE8	6	
Total	**180**		**36**	

Tab 1c. IZIIS POST-GRADUATE STUDIES IN STRUCTURAL ENGINEERING AND SEISMIC DESIGN (Programme-1)

Tab 1.c1. SEMESTER III: Preparation and public defense of master thesis

NO.	Time duration (months)	Preparation phases	Credits	Activity
MT-301	0.5	Selection of topic		The candidate consults the mentor
MT-302	5	Elaboration of master thesis		The candidate consults the mentor
MT-303	0.5	Public defense		The candidate defends the thesis in public
Total	**6 months**		**30**	

Appendix- B2:

REVIEW OF CURRICULUM:

LIST OF OBLIGATORY AND OPTIONAL SUBJECTS OF THE IZIIS MASTER STUDIES IN EARTHQUAKE ENGINEERING (Programme-2)

Tab 2a. IZIIS POST-GRADUATE STUDIES IN EARTHQUAKE ENGINEERING (Programme-2)

Tab 2.a1. SEMESTER I: Obligatory subjects

No.	No. of lecture hours	Subjects	Credits	Lecturers (from IZIIS and invited)
EE-101	30	Dynamics of Structures	6	
EE-102	30	Analysis of Structures	6	
EE-103	30	Engineering Seismology	6	
EE-104	30	Dynamics of Soils and Foundations	6	
Total	**120**		**24**	

Tab 2.a2. SEMESTER I: Optional subjects (to be selected one (1) from the list)

No.	No. of lecture hours	Subjects	Credits	Lecturers (from IZIIS and invited)
EE-105	30	Experimental Mechanics	6	
EE-106	30	Engineering Materials	6	
EE-107	30	Finite Element Analysis	6	
EE-108	30	Introduction to MATLAB and its application in engineering analyses	6	
Total	**120**		**24**	

Tab 2b. IZIIS POSTGRADUATE STUDIES IN EARTHQUAKE ENGINEERING (Programme-2)

Tab 2.b1. SEMESTER II: Obligatory subjects

No.	No. of lecture hours	Subjects	Credits	Lecturers (from IZIIS and invited)
EE-201	30	Aseismic Design of RC, Steel and Masonry Structures	6	
EE-202	30	Seismic Risk and Vulnerability Analysis	6	
EE-203	30	Project Planning and Management	6	
Total	**90**		**18**	

Tab 2.b2. SEMESTER II: Optional subjects (to be selected one (1) from the list)

No.	No. of lecture hours	Subjects	Credits	Lecturers (from IZIIS and invited)
EE-204	30	Earthquake Resistance of RC Buildings	6	
EE-205	30	Analysis of Seismic Resistance of Steel, Masonry and Timber Structures	6	
EE-206	30	Planning and Design of Transportation Systems and Other Infrastructure Systems in Seismically Prone Regions	6	
EE-207	30	Aseismic Design of Dams	6	
EE-208	30	Repair and Strengthening of Structures	6	
EE-209	30	Seismic Analysis and Design of Special Structures	6	
EE-210	30	Design with Application of EUROCODE 8	6	
Total	**210**		**42**	

Tab 2c. IZIIS POST-GRADUATE STUDIES IN EARTHQUAKE ENGINEERING (Programme-2)

Tab 2.c1. SEMESTER III: Preparation and public defence of master thesis

No.	Time duration (months)	Preparation phases	Credits	Activity
MT-301	0.5	Selection of topic		The candidate consults the mentor
MT-302	5	Elaboration of the master thesis		The candidate consults the mentor
MT-303	0.5	Public defense		The candidate defends the master thesis in public
Total	**6 months**		**30**	

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: **Assoc. 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: **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: Prof. Dr. Veronika Sendova
Other lecturers: Assoc. 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: Assoc. 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: **Assoc. Prof. Dr. Vlatko Sesov**
Other lecturers: **Assoc. 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, senior 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: **Assoc. 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: 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: **Assoc. Prof. Dr. Roberta Apostolska**
Other lecturers: **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: **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:
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*

APPENDIX - C2:

DESCRIPTION OF CURRICULUM PER OBLIGATORY AND OPTIONAL SUBJECTS WITHIN THE IZIIS' MASTER STUDIES IN EARTHQUAKE ENGINEERING (Program-2)

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

Curriculum of IZIIS' Postgraduate Studies

Earthquake Engineering Major (Curriculum – 2)

Enrollment conditions:

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

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

Contents of the subject:

1. Single degree of freedom systems:
1.1. Equations of motion, problem statement and solution methods;
1.2. Free vibrations;
1.3. Response to harmonic, periodic, random and impulse excitations;
1.4. Numerical evaluation of dynamic response;
1.5. Earthquake response of linear and nonlinear systems;
1.6. Generalized single degree of freedom systems.

2.Multi degree of freedom systems:
2.1. Equations of motion, problem statement and solution methods;
2.2. Free vibration, damping in the structure;
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. Earthquake response and design of multistory buildings:
3.1. Earthquake 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, Anil Chopra***

Additional: Dynamics of Structures, Mario Paz; Dynamics of Structures, Pensien and Clough, Special chapters from Dynamics of Structures, Trifun Paskalov, Dynamics of Structures – Constantine Mescouris

	Subject: ANALYSIS OF STRUCTURES			
Code	***Status***	***Semester***	***Number of ECTS credits***	***Number of lecture hours***
EA-102	***Obligatory***	***/***	***6***	***30***

Curriculum of IZIIS' Postgraduate Studies

Earthquake Engineering Major (Curriculum – 2)

Enrollment conditions:

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

Principal lecturer: **Prof. Dr. Danilo Ristic**
Other lecturers: **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: element and structure stiffness formulation, solution methods. Flexibility (force) method: concept and applicability. Computer implementation: solution strategies, basic linear static and dynamic analysis procedures. Theory of large deflections and stability analysis. Introduction to structural analysis theory of nonlinear structures: fundamentals of plastic analysis of structures. Plastic hinge. Elastic-plastic analysis of beams and frames. Basic principles of limit analysis. Influence of axial forces and interaction with bending moments. Fundamentals of FEM application in static model formulation. Fundamentals of FEM application in formulation of models for static analysis. Fundamentals of application of FEM in formulation of models for dynamic analysis. General methods for dynamic problem solution: general equation of motion, step-by-step numerical integration methods, 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 problems). Introduction to static and dynamic analysis of special structures: analysis of complex systems exposed to combined loads, analysis of seismically isolated structures, analysis of structures with elements for energy dissipation and vibration control. 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*	*/*

Grading:

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

References: *Main: Notes containing lectures for the international IZIIS-DAAD master studies prepared by Prof. Dr. D. Ristic*
Additional: Selecteed new relevant scientific papers

	Subject: ENGINEERING SEISMOLOGY			
Code	***Status***	***Semester***	***Number of ECTS credits***	***Number of lecture hours***
EA-103	***Obligatory***	***/***	***6***	***30***

Curriculum of IZIIS' Postgraduate Studies

Earthquake Engineering Major (Curriculum – 2)

Enrollment conditions:

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

Principal lecturer: Assist. Prof. dr. Dragi Dojcinovski
Other lecturers: Prof. Dr. Snezana Stamatovska
Visiting professors:

Contents of the subject:

1. Earthquake phenomenon: introduction; reasons for occurrence of earthquakes; types of earthquakes; earthquake parameters: focus; epicenter, depth, epicentral distance, seismic energy; tectonics; faults, seismic waves – types; definition of earthquake size: intensity, magnitude, seismic scales, ground motion parameters.

2. Engineering aspects of earthquakes: regional seismological characteristics: seismotectonic model; concept of bedrock; predominant periods and time duration of individual regional parameters of ground motion; amplitude; attenuation; local seismological effects: approaches using engineering-geological seismic impedance and dynamic response in analysis of soil media; geotechnical investigations; microtremors, predominant periods and equivalent soil models, earthquake records; processing and interpretation of records, response spectra: concept, spectral parameters, relationships; spectral characteristics and structure; linear and nonlinear spectra, effective response spectra and compatible time histories.

3. Seismic hazard analysis: methodology, deterministic and probabilistic approach; seismic hazard elements, seismic models, earthquake recurrence curves, probabilistic models (Poisson's, Markov's model, etc.) for generation of earthquakes, attenuation , methods and models for computation of seismic hazard, results, application: seismic hazard map, diagram of return periods, concept of return period.

4. Seismic design parameters: seismic risk, concept of return period, design parameters based on seismic hazard and risk analysis (acceleration, velocity, displacement, time duration), parameters at bedrock and foundation levels: effect of local soil conditions – dynamic amplification factor, response spectra, artificial accelerogrammes, time histories, seismic design criteria: design and maximum earthquake, seismic zoning, microzoning, regulations.

5. Seismic monitoring: need for seismic monitoring, basic principles, project for seismic monitoring, monitoring of engineering structures (highrises, bridges, dams, etc.), processing and application of obtained results

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*

References: *Main:Mimeographed notes containing lectures for master studies prepared by V. Mihailov and D. Dojcinovski*
Additional: Selected papers

	Subject: DYNAMICS OF SOIL AND FOUNDATION			
Code	***Status***	***Semester***	***Number of ECTS credits***	***Number of lecture hours***
EA-104	***Obligatory***	***/***	***6***	***30***

Curriculum of IZIIS' Postgraduate Studies

Earthquake Engineering Major (Curriculum – 2)

Enrollment conditions:

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

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

Contents of the subject:

Dynamic properties of soils
- Dynamic stress-strain relationships
- Factor influencing dynamic parameters of soils
- Laboratory methods for definition of dynamic parameters of soil
- Field investigations

Dynamic response of soils
- Numerical modelling of local soil conditions
- Dynamic response of soil medium

Soil instabilities
- Landslides
- Liquefaction

Soil-structure interaction
- Vibration of foundation
- Seismic performance of deep foundation
- Dynamic soil-structure interaction

Improvement of soil
- Methods for improvement
- Decreasing of liquefaction potential
- Structural measures for protection

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: Mimeographed notes prepared by Prof. Dr. Kosta Talaganov*

Additional: Numerous selected papers from professional journals; Behaviour of Soils in Seismic Geotechnics by Kenji Isihara, Klaredon Press – Oxford, 1996

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

Curriculum of IZIIS' Postgraduate Studies

Earthquake Engineering Major (Curriculum – 2)

Enrollment conditions:

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

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

Contents of the subject:

1. Introduction to experimental mechanics; importance and need for physical modelling in earthquake 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, production. Materials for physical models; plastics, epoxy resins, metals and alloys, micro concrete, gypsum and gypsum-sand mixtures, reinforcement simulation. Modelling 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. Fields of application. 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. Procedure for quasi-static testing. Loading histories. Controlled variables. Examples of quasi-static testing: wall elements, frame structures, shear-wall systems, steel systems.
6. Full-scale testing of structures. Need and objectives of the tests; testing methods, testing by forced vibration method: theory, equipment, procedure, identified characteristics. Testing by 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 cells, accelerometers, displacement transducers, strain gauges. Wheatstone bridge; measurement of axial force, moment. Data acquisition.
8. Analysis of experimental data. Errors during experimental testing of models of structures. Statistic analysis. Probabilistic analysis. Methods for fitting of data; 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 materials prepared by lecturers*
Additional: *Papers and other materials, video materials*

	Subject: ENGINEERING MATERIALS			
Code	***Status***	***Semester***	***Number of ECTS credits***	***Number of lecture hours***
EA-106	***Optional***	***I***	***6***	***30***

Curriculum of IZIIS' Postgraduate Studies

Earthquake Engineering Major (Curriculum – 2)

Enrollment conditions:

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

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

Contents of the subject:

1. Introductory notes: role of materials science in engineering; why should materials be studied, classification of materials, modern needs.
2. Atomic structure and itner-atomic bonding“ main concepts; primary inter-atomic bonding; secondary inter-atomic bonding; molecules.
3. Structure of crystal materials: crystal structure, crystal vectors and plains, crystalline and non-crystalline materials.
4. Structure and mechanical characteristics of metals: main concepts; elastic deformations, (stress-strain relationship, characteristic of materials); plastic deformations, (characteristics under tension, compression, shear and torsion, real and engineering stress and strain, hardness of materials, design factors and safety factors). Phase diagrams in alloys: definitions and main concepts, phase diagrams in ferro-carbonate alloys. Smart materials: main principles and application.
5. Failure: fundamentals of rigid and ductile failure; principles of failure mechanics; fatigue of materials (S-N curves, initial opening and propagation of cracks, factors affecting fatigue); creeping of materials (behaviour at creeping, effects of level of stress and temperature);
6. Structure and characteristics of ceramincs: crystal structure, phase diagrams, mechanical characteristics (stress-strain relationship, mechanisms of plastic deformations, advantages and setbacks, application in civil engineering);
7. Structure and characteristics of polymers: characteristics of hydrocarbon molecules, mechanical and thermo-mechanical characteristics of polymers, advantages and setbacks, application in civil engineering.
8. Composite materials: characteristics of: (1) composite materials strengthened by strips, (2) composite materials strengthened by fibers, (3) laminated composite materials; application of composite materials in civil and earthquake engineering;
9. Economic and social aspects in science and design of materials: design of components of materials, techniques of construction, possibilities for recycling.

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: Materials Science and Engineering – An Introduction, W.D. Callister – selected chapters*
Additional: *Selected scientific papers*

	Subject: FINITE ELEMENT ANALYSIS			
Code	***Status***	***Semester***	***Number of ECTS credits***	***Number of lecture hours***
EA-107	***Optional***	***II***	***6***	***30***

Curriculum of IZIIS' Postgraduate Studies

Earthquake Engineering Major (Curriculum – 2)

Enrollment conditions: Theory of Structures & Application

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

Principal lecturer: 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, 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 a 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, O.C. Zienkievic and R.L. Taylor, 4 Edition, 1989.*
Additional: *Finite Element Procedures, K. J. Bath, Prentice Hall, 1996, Introduction to FEM, J. N. Redy.*

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

Curriculum of IZIIS' Postgraduate Studies

Structural Engineering & Seismic Resistant Design Major (Curriculum – 1)

Enrollment conditions:

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

Principal lecturer: Dr. Katarina Manova, senior 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:	SEISMIC DESIGN OF RC, STEEL AND MASORNY STRUCTURES		
Code	**Status**	**Semester**	**Number of ECTS credits**	**Number of lecture hours**
EA-201	**Obligatory**	**II**	**6**	**30**

Curriculum of IZIIS' Postgraduate Studies

Earthquake Engineering Major (Curriculum – 2)

Enrollment conditions: Dynamics of Structures and Analysis of Structures

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

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

Contents of the subject:

Experience from occurred earthquakes – damages to structures caused by recent earthquakes. Behaviour of structures under the effect of earthquakes and dynamic loads. Seismic design concepts; seismic design and seismic behaviour (ultimate states of seismic design; characteristics of structures).

Seismically resistant structural systems (structural systems to sustain seismic forces, effect of structural configuration upon seismic response, classification of structures in respect to designed ductility level).

Definition of design quantities (design loads and forces, design load combinations, definition of strength, strength reduction factors, seismic forces).

Basic principles of seismic design of buildings and safety criteria. Methodology and apporach to seismic design of structures.

Philosophy of design based on structural capacity (main characteristics, illustrative analogy, design based on capacity of structures (illustrative example).

Comparison of seismic forces obtained according to different regulations. Brief review of existing seismic regulations.

Method:

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

Grading:

Attendance of lectures	*Obligatory tasks*	*Colloquia*	*Seminar papers*	*Written examination*	*Oral examination*
10%	/	/	/	/	*90%*

References: *Main: Seismic Design of Reinforced Concrete and Masonry Structures, Pauley and Pristley 1992, Design of Aseismic Buildings, Wakabayashi, McGroy Hill Book Company 1986, Eurocode 8, Design of Seismically Resistant Structures, Part 1-1 General Rules. Seismic Effect and Rules for Buildings*

Additional: *Instrictive material prepared by the IZIIS' lecturers in the subject*

	Subject:	SEISMIC RISK AND VULNERABILITY ANALYSIS		
Code	***Status***	***Semester***	***Number of ECTS credits***	***Number of lecture hours***
EA-202	***Obligatory***	***II***	***6***	***30***

Curriculum of IZIIS' Postgraduate Studies

Earthquake Engineering Major (Curriculum – 2)

Enrollment conditions: Engineering Seismology

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

Principal lecturer: Prof. Dr. Zoran Milutinovic
Other lecturers:
Visiting professors:

Contents of the subject:

Overview of fundamentals of seismic hazard analysis

Seismic source parameters; effects of local site conditions; principal collateral hazards: landslides, liquefaction, tsunamis; seismic parameters for vulnerability and risk analysis.

Earthquake damage and usability classification

Inventory of elements at risk; damage and usability classification of buildings, transportation systems and lifelines, facilities with essential emergency functions, facilities with a potential to suffer huge losses.

Concept of vulnerability, vulnerability/Fragility functions

Empirical, experimental and analytical vulnerability functions for buildings and structures; vulnerability of earthquake non-resistant and earthquake resistant structures; damage potential and vulnerability of infrastructure and utility systems.

Seismic risk analysis

Inventory, presentation and density distribution of elements at risk, loss prediction potential, loss per element at risk, cumulative loss analysis and presentation; seismic risk analysis; optimisation of seismic risk, acceptable level of seismic risk.

GIS technology for seismic risk assessment

Introduction, current state-of-the-art, inventory, data attributization and matching, development and structuring of layers, analysis, thematic mapping, generation of results, decision making, traditional versus dynamic system for support to decision making, new technologies for monitoring and managing of risk pertaining to catastrophes.

Method:

Lectures	*Exercises*	*Numerical and Graphical tasks*	*Use of software*	*Laboratory exercises*	*Seminar papers*	*Field lectures*
60%	*/*	*20%*	*/*	*/*	*20%*	*/*

Grading:

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

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

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

Curriculum of IZIIS' Postgraduate Studies

Structural Engineering & Seismic Resistant 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:	EARTHQUAKE RESISTANCE OF RC BUILDINGS		
Code	***Status***	***Semester***	***Number of ECTS credits***	***Number of lecture hours***
EA-204	***Optional***	***II***	***6***	***30***

Curriculum of IZIIS' Postgraduate Studies

Earthquake Engineering Major (Curriculum – 2)

Enrollment conditions: Dynamics of Structures, Analysis of Structures, Seismic Design of RC, Steel and Masonry Structures

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

Principal lecturer: **Prof. Dr. Golubka Necevska - Cvetanovska**
Other lecturers: **Assoc. Prof. Dr. Roberta Apostolska**
Visiting professors:

Contents of the subject:

Strength and deformability characteristics of concrete and steel exposed to cyclic loads. Nonlinear behaviour of RC structural elements. Main principles of nonlinear analysis of RC cross-sections and elements; effect of bending, axial forces and shear forces; confinement; ductility.

Design of RC buildings; philosophy of design; design according to different regulations. Strength and ductility capacity of structural elements; nonlinear behaviour of RC beams and columns under the effect of monotonous and cyclic loads; methodology for definition of strength and displacement capacity of structural elements and buildings. Analysis of inelastic response of RC buildings exposed to different earthquakes; hysteretic behaviour of RC buildings. Methodology for seismic design of new RC structures and evaluation of seismic resistance of existing RC structures (RESIST-INELA methodology). Numerical example: analysis, design and evaluation of seismic resistance of a five-storey RC building.

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*
10%	*/*	*2 x 20%*	*40%*	*40%*	*10%*

References: *Main: Design of Earthquake Resistant Buildings, Wakabayashi, McGraw-Hill Book Company, 1986, Seismic Design of Reinforced Concrete and Masonry Buildings, Paulay and Priestley, 1992, Reinforced Concrete Structures, Park and Paulay, 1975, Eurocode 8: Design of Structures for Earthquake Resistance, Part 1-1: General Rules, Seismic Action and Rules for Buildings.*

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

	Subject:	ANALYSIS OF SEISMIC RESISTANCE OF STEEL, MASONRY AND TIMBER STRUCTURES		
Code	**Status**	**Semester**	**Number of ECTS credits**	**Number of lecture hours**
EA-205	**Optional**	**II**	**6**	**30**

Curriculum of IZIIS' Postgraduate Studies

Earthquake Engineering Major (Curriculum – 2)

Enrollment conditions:

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

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

Contents of the subject:

Steel structures: learning from past earthquakes - damage to steel structures during recent earthquakes. Classification of failure mechanisms. Study of nonlinear behavior of steel structural elements - beams, columns and joints under monotonic and cyclic loads. Steel structural systems in seismic areas. Evaluation of q-factor. Seismic design of steel structures. Design methodology based on ductility. Required ductility, ductility capacity of seismically resistant steel structures. Recommendations for seismic design of different steel structural systems. Numerical example – design and evaluation of seismic resistance of a steel structure.

Masonry structures: introduction; behaviour of masonry structures during earthquakes: analysis of occurred damage, failure mechanism of individual walls, failure mechanisms in structures, reasons for failure of masonry structures; seismic resistance of existing masonry structures: analysis of bearing capacity of plain, framed and reinforced masonry; analysis of deformability capacity of plain, framed and reinforced masonry; seismic resistance of cultural historic structures and monuments; numerical examples: evaluation of seismic resistance of an existing masonry structure.

Timber structures: introduction: behaviour of timber structures during earthquakes: analysis of occurred damage, failure mechanisms, reasons for damage and failure of timber structures; seismic resistance of existing timber structures.

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: Theory and Design of Seismically Resistant Steel Frames, F. M. Mazzolani and V. Piluso, Chapman & Hall, 1996, Ductility of Seismic Resistant Steel Structures, V. Giancu and F.M. Mazzolani, Spon 2000, Seismic Design of Wood and Masonry Buildings, The Seismic Design Handbook, F. Naeim 2000, Earthquake Resistant Design of Masonry Buildings by M. Tomazevic, Eurocode 8: Design of Structures for Earthquake Resistance, Part 1-1: General Rules, Seismic Action and Rules for Buildings.*

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

	Subject:	PLANNING AND DESIGN OF TRANSPORTATION SYSTEMS AND OTHER INFRASTRUCTURE SYSTEMS IN SEISMIC REGIONS		
Code	***Status***	***Semester***	***Number of ECTS credits***	***Number of lecture hours***
EA-206	***Optional***	***II***	***6***	***30***

Curriculum of IZIIS' Postgraduate Studies

Earthquake Engineering Major (Curriculum – 2)

Enrollment conditions:

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

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

Contents of the subject:

Typical earthquake damage to bridges: effects of site conditions and structural configuration, damage to substructures, bearings and superstructures. Seismic analysis of bridges: concept of a single-degree-of-freedom system, concept of a multi degree-of-freedom system, application of response spectrum, linear dynamic analysis, nonlinear dynamic analysis. Nonlinear expert analysis of bridges: classification, general guidelines, nonlinear section analysis, formulation of nonlinear models, nonlinear analysis of integral bridges. Seismic design philosophy: basic seismic design philosophy, performance-based criteria, performance–based design. Seismic design of reinforced concrete bridges: Performance of columns, flexural and shear design of piers, pier-beam connections, pier–footing design. Seismic design of steel bridges: ductile moment resisting frame, ductile braced frame, combined systems. Seismic isolation of bridges: basic concept, modeling and analysis, modeling of seismic isolation and energy dissipation devices, performance and testing requirements, design guidelines. Soil-foundation-structural interaction: Typical problems, characterization of soil-foundation-structure interaction. Seismic retrofitting: information system, identification, prioritization, performance criteria, structural state diagnosis, retrofit design. Structural health monitoring, dynamic in-situ testing, seismic instrumentation of bridges, bridge maintenance. Seismic design of transportation systems and lifelines: seismic parameters, collateral hazards (fault rupture, landslides, rock falls, liquefaction, tsunamis). Damage and vulnerability assessment: vibration induced effects, ground failure along the routes and specific structural systems, earthquake damage classification and damage potential. Planning and design of regional and urban lifelines: water supply systems, gas systems, design of specific structures, pipelines, underground structures; principal 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: SEISMIC DESIGN OF DAMS			
Code	***Status***	***Semester***	***Number of ECTS credits***	***Number of lecture hours***
EA-207	***Optional***	***II***	***6***	***30***

Curriculum of IZIIS' Postgraduate Studies

Earthquake Engineering Major (Curriculum – 2)

Enrollment conditions:

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

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

Contents of the subject:

1. Seismic design of gravity and arch dams. Seismic behavior of dams and types of damage due to occurred earthquakes. Definition of principal 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, stiffness, mass, damping. Analysis of discontinuities, i.e., structural and parametric joints. Definition of parameters of contact elements. Field surveys and analysis of natural vibrations. Linear and nonlinear stress-strain state. Stability criteria. Instructions for improvement of seismic safety in design of dams.

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 change of pore pressure upon stability of dams. Dynamic response of dams. Characteristics of natural vibrations, effect of geomechanical characteristics of materials present upon the dynamic response. Effect of dam-reservoir-foundation interaction. Effect of the dam geometry upon the stress-strain state. Stability criteria. Instructions for improvement of the 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 analysis of dams.

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*
5%	*5%*	*/*	*30%*	*30%*	*30%*

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

	Subject:	REPAIR AND STRENGTHENING OF STRUCTURES		
Code	***Status***	***Semester***	***Number of ECTS credits***	***Number of lecture hours***
EA-208	***Optional***	***II***	***6***	***30***

Curriculum of IZIIS' Postgraduate Studies

Earthquake Engineering Major (Curriculum – 2)

Enrollment conditions:

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

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

Contents of the subject:

REPAIR AND STRENGTHENING OF BUILDINGS

Introduction: post-earthquake damage evaluation and emergency measures for temporal protection, data collection, evaluation of damage, inspection and recommendations, short and long term activities for elimination of earthquake consequences;

Repair and strengthening design procedure: criteria for repair and/or strengthening, definition of characteristics of material, definition of capacity and required strength, stiffness and deformability of structural elements and integral systems, damage evaluation and selection of repair and/or strengthening solution; materials, methodology and technique of strengthening; conventional concrete, , special concrete and mortar, polymer modified concrete, gunite concrete, resins, grouting, epoxides and other.

Repair and strengthening of R/C structures: columns, beams, beam-column joints, shear walls, slabs;

Repair and strengthening of structural systems and introducing new elements as shear walls, infill walls, wing walls, etc.; analysis and detailing.

Masonry structures: repair of walls, strengthening of walls by ties (steel sections), R/C jacketing, injection, construction techniques, method for analysis and design procedure.

Special structures and industrial facilities: bridges, lifeline systems, industrial facilities and equipment experimental investigations, codes and regulations, experience and recent knowledge.

REPAIR AND STRENGTHENING OF MONUMENTS

Introduction: (significance of cultural heritage, definitions, criteria and strategy, earthquake protection of historic buildings and monuments); specific characteristics of masonry in historic structures: (materials, structural elements, experimental and analytical inverstigations of materials and structures); Material and methods for repair, structural strengthening and conservation; case studies: (Byzantine Monuments in Macedonia, reconstruction and rebuilding of monuments, examples of repair and strengthening of monuments in the world).

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 the lecturers in the subject*
Additional: *Selected scientific papers*

	Subject:	SEISMIC ANALYSIS AND DESIGN OF SPECIAL STRUCTURES		
Code	**Status**	**Semester**	**Number of ECTS credits**	**Number of lecture hours**
EA-209	*Optional*	*II*	*6*	*30*

Curriculum of IZIIS' Postgraduate Studies

Earthquake Engineering Major (Curriculum – 2)

Enrollment conditions:

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

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

Contents of the subject:

Main concept of design of seismically resistant structures

General concept: earthquake levels, seismic categorization of structures, systems and components, combination of seismic loads and other loads, allowable stress and strain limits, procedure and approach to definition of seismic excitation, damping values.

Modeling techniques. Analytical approaches for main structures. Design aspects for primary structures. Seismic aspects related to secondary systems: seismic qualification. Uncertainties in seismic design and analysis.

New technology for design of seismically resistant structures

Base isolation:
- Introduction
- Principles of base isolation
- Types of isolators and their characteristics
- Isolation of buildings
- Isolation of bridges

Passive energy dissipation systems
- Introduction
- Principles and types of dampers
- Design with damping
- Practical application (examples)

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*
10%	*20%*	/	/	*70%*	/

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

	Subject:	DESIGN BY APPLICATION OF EUROCODE 8		
Code	***Status***	***Semester***	***Number of ECTS credits***	***Number of lecture hours***
EA-210	***Optional***	***II***	***6***	***30***

Curriculum of IZIIS' Postgraduate Studies

Earthquake Engineering Major (Curriculum – 2)

Enrollment conditions:

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

Principal lecturer: **Prof. Dr. Mihail Garevski**
Other lecturers: **Prof. Dr. Golubka Necevska 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 guidelines;
2. Fundamental requirements and requirements for structural „performance“;
3. Soil conditions and seismic effects;
4. Design of seismically resistant buildings (basic principles, analysis of structures, verification of seismic safety);
5. Specific requirements (rules) for reinforced-concrete buildings (definitions, design concepts, design guidelines for specific elements and details);
6. Specific requirements for steel buildings (definitions, design concepts, specific design guidelines 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 guidelines);
9. Specific requirements for masonry structures (main requirements and design guidelines);
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*