

Πρόταση συνεργασίας TUC-Technion (Israel)

A. QUALITY OF PROJECT DESIGN AND COOPERATION ARRANGEMENTS

Ερώτημα Α (Σε επίπεδο Σχεδίου/για όλες τις προτάσεις συνεργασίας με ιδρύματα, 40 βαθμοί)

TUC is an outward looking HEI, whose main aim is to provide high-quality education to students and research opportunities to staff members, driven by excellence in research, teaching and innovation, through strong ties with international organizations that give complementarity and add to the excellence standard of the entire team. In 2016, the external Higher Education Evaluation committee ranked it amongst the 10 best achieving institutions in Greece. The same year, TUC submitted a successful application at the ICM Call. In the last 27 years has signed a significant number of MoUs, more than 100 Inter-Institutional Agreements under Erasmus program and has received and sent hundreds of international distinguished academics, scholars and students to and from European and non-European Universities (Israel, Jordan, U.S.A, China, Botswana, Canada, South Africa, Armenia, Ecuador, Laos, Serbia, Chile, India, New Zealand). After the end of the inter-institutional agreements, channels of cooperation are maintained either at the level of Faculties or at the level of research working groups between the partner Institutions. For this reason, the cooperation with the majority of the Institutions continues in the plans 2019-22 and 2020-3 within the framework of the international mobility program. Although the majority of the Institutions expressed interest in continuing the collaborations under the same program, the TUC in the new mobility plan (call 2022) gave priority to collaborating with new Institutions in the same educational fields in order to expand its global cooperation network on international issues.

Preparation for the submission of the cooperation proposal: The responsible persons for the implementation of the program are predetermined **in writing**, while pre-agreed the observance of the principles and procedures, as foreseen in the inter-institutional agreement. In the preliminary cooperation agreement both Institutions have defined: Erasmus management officers for the implementation of the program (TUC: Markos Ntoukakis/Erasmus office) and Inclusion Officers (TUC: Lefteris Maragkoudakis/Erasmus office) who undertake to reach out and increase accessibility to more participants with fewer mobility opportunities. In addition, Erasmus academic Institution coordinators (TUC: Prof. Michael Zervakis/**Vice Rector**) and the legally responsible for the conclusion of the inter institutional agreement (TUC: Prof. Evangelos Diamantopoulos /Rector). Erasmus Offices of the partner Institutions communicate with e-mail, skype, cloud storage services (Dropbox) for file sharing on the needs of the project. Basic parameters of the cooperation have been regulated, such as the procedures for the information of the academic communities and the invitation ways to participation in mobility, the selection criteria for applicants and the recommendation of the evaluation committee. In addition it is identified the educational field(s) of the project, the participating faculties from each Institution, the academic coordinators from each faculty (TUC: <https://www.tuc.gr/index.php?id=12861&L=928%27>) and academic calendars are exchanged (TUC: <https://www.tuc.gr/index.php?id=3624>). Specifically, for student mobility (1st, 2st cycle) the Erasmus officers exchange information about the required language skills and the offered courses of each faculty (TUC: <https://www.tuc.gr/index.php?id=534&L=928%27>). Also, information is exchanged regarding the professors who can supervise thesis for students and for those who can contribute the activities of incoming staff, for the organizations that can employ students for traineeship and for the required language skills of incoming participants in each institution. After the mobility grant, each Erasmus officer will post announcements on the official websites and social media accounts about the procedures and benefits of the Erasmus program. The Inclusion officers will post information about the possibilities, the criteria and the capabilities of the program for the support of vulnerable groups. At the same time, the Erasmus officers in collaboration with the academic coordinators of participating faculties of each Institution will relate the offered courses for the incoming

Erasmus students. The inter-institutional agreement will then be checked by the Erasmus Institution Coordinator and be signed by the legal representative of each Institution. After the signing, the Erasmus officers and the Inclusion officers will post invitation on the media and sessions will be organized to inform the academic communities for the approved mobilities. The invitation to participate in the program for staff and students by the Erasmus officers will be composed in the pre-agreed way at the same time in both Institutions if this is possible for better control of the process. Applicant outgoing students from TUC evaluated by the motivation to participate in mobility, from their activities in the specific educational field, while priority will be given to students with fewer opportunities to participate in mobility. A point allocation system evaluate outgoing staff of TUC, based on the years of their employment at TUC, the time since the last participation in mobility and the submitted activity plan. Erasmus officer at the Partner Institution informs in writing the Erasmus office of TUC about the procedures of information, selection and evaluation of the candidates. In this way, TUC as the coordinator of the program ensures a selection process fair, transparent and documented, ensuring equal opportunities to participants eligible for mobility. Details for the pre-planning of the cooperation with each candidate Institution are given in in the corresponding section.

Before the mobility: The required arrangements in the Inter institutional Agreement to support the participants before the mobility for procedures related to visa, insurance, travel, accommodation, integration and linguistic support of students will be implemented in collaboration with the Erasmus officers and Inclusion officers of both Institutions. They are responsible to post information on the websites of their institutions about the above procedures and to provide administrative support and advice to participants. Incoming students at each Institution can receive additional information for the planning of their studies from the Erasmus academic coordinators of each faculty and from professors who specialize in the educational field of the cooperation and have stated that they can co-supervise their thesis. Incoming staff at each Institution can receive additional information from members of TUC who specialize in the same education field and have stated that they can contribute to their activities. In this way, the participants will have all the information for the planning of their activities in the mobility agreements. Incoming students to TUC can receive additional information about their stay in Chania from the [Erasmus Student Network](https://tuc.esngreece.gr/about-us) (ESN) at TUC (<https://tuc.esngreece.gr/about-us>). The Inter-institutional agreement clearly states that TUC's Erasmus office will manage the OS and will be responsible for uploading and updating the Mobility Tool. Under the terms of the Erasmus Program, students will not be required to pay any tuition fees to the host Institution. TUC, as applicant and Coordinator, will be in charge for the financial management, conforming to the guidelines and policies of the European Commission and the National Agency (IKY). All grants and travel expenses of the Erasmus+ International Credit Mobility Program participants will be covered by the TUC. The data required for the signing of the grant agreement (visa, insurance contract, bank account, tickets) will be collected and checked by the Erasmus office of TUC. The prepayment (80%) will be granted to participants at least one month before the start of mobility. The disbursement of money and their deposit in the bank accounts of the participants is a responsibility of finance department of TUC, "Special Account for Research Funding–ELKE" (<https://www.elke.tuc.gr/en/home>) in collaboration with the Erasmus office of TUC.

During the mobility: In addition to the participant support procedures mentioned in the inter-institutional agreement, upon arrival of the grantees, TUC Erasmus Office will organize a campus-tour and a meeting in order to inform the applicants regarding the city, the transportation and the campus life. TUC will offer free the student ID card and full access to classic core ICT services (e.g. e-mails account, Wi-Fi, etc), to library, in campus sports installations, at meals and in public transport at low prices. TUC's Language Research and Resources Center contribute to the improvement of the linguistic skills of Greek students by offering free of charge lessons in English language and free lessons in Greek language to incoming students. Students and academic staff with physical disabilities have full access to all above activities and services. There are spacious elevators and parking facilities, so that all the physical barriers are eliminated and many laboratories are on the ground floor. TUC will integrate incoming students and staff by encouraging them to participate in students' associations and campus life, cultural activities and visits. The Erasmus academic coordinators of

participating faculties will attend their studies in the courses provided in the learning agreements. An appointed team of Professors will co-supervise the progress of their dissertation and will also draw a final report at the end of their mobility period, in order to facilitate the recognition of the learning outcomes. Incoming students are expected to participate to presentations, seminars, conferences or other academic and scientific activities in order to diffuse the acquired and gained knowledge. Particularly important is the contribution of the Erasmus student association (ESN) for the integration of incoming students in community of TUC and in the social life of the city.

After the mobility: The original Certificate of Attendance that will be handed from the Erasmus officer of TUC will be the proof of recognition for the mobility period. Erasmus officer at the partner institution will be required to provide written recognition of the courses and postgraduate and doctoral studies (part of thesis) for TUC outgoing students. After the final check of all the presented documents, the participants will receive from ELKE the remaining 20% of the grant. After the end of mobility, participants have to submit the EU Report. The final reports in combination with the open-ended questionnaire to the participants are used to evaluate each mobility. In short, participants are asked if they have implemented the planned activities and if they are satisfied with the services (information, criteria for selecting participants, measures to support vulnerable groups) provided by Erasmus offices and academic coordinators from each institution before, during and after mobility. Every answer must be justified. The processing of the participants' reports in combination with the above questionnaire and the final evaluation of the project by the IKY are used as indicators for the evaluation of the project and are discussed in a special session of the Erasmus office contributes to the continuous improvement of the implementation of the mobility program. Participants' activities post on the Erasmus website and presented by them at an event organized by the Erasmus Office after the end of each mobility project, which is attended by the entire academic community. In this meeting, the participants discuss the benefits and potential problems that arose during the project and propose solutions to improve the planning and management of the mobility program.

B. RELEVANCE OF STRATEGY Ερώτημα Β (Σε επίπεδο Ιδρύματος, 40 βαθμοί)

The [School of Mineral Resources Engineering](#) (MRED) of TUC submits a proposal for bilateral collaboration with the Institute of Technology “[Technion](#)” in Haifa, Israel, in the academic and scientific fields of “Chemical engineering and processes” and “Physical sciences” (ISCED codes: 0711,053), and more specifically in scientific subject of “Immiscible multiphase flows through geologic porous media”.

Technion is a world-leading engineering university in Haifa, Israel, with vast experience in managing international agreements to support students and researchers' mobility, as well as academic exchange, through the Technion International School (<https://int.technion.ac.il/>). Technion International was founded in 2009 in order to oversee Technion's international academic endeavors. Technion International offers a variety of programs, including full undergraduate and graduate programs, postdoctoral fellowships, study abroad programs, summer programs for gifted teens, research internships, as well as entrepreneurship programs. As of 2018, Technion has academic collaboration agreements with 232 universities in 41 countries and 36 medical school agreements.

Technion International is part of the Erasmus+ initiative. It is also a member of CLUSTER (Consortium of Leading Universities of Science and Technology), Global-E3 (Global Engineering Educational Exchange), CMU (Community of Mediterranean Universities) and IAU (International Association of Universities). Semester Abroad is geared towards university students from all over the world who wish to study at Technion International for a semester. Classes in English language are offered in the faculties of Civil Engineering, Environmental Engineering, Aerospace Engineering, Chemical Engineering, Biology, Biotechnology Engineering, Electrical Engineering, Materials Engineering, Mechanical Engineering and Pre-medical. Students choose between a Winter and a Spring semester. Technion International has also two international affiliates:

the Jacobs Technion-Cornell Institute with partnership with Cornell University, and the Guangdong Technion Israel Institute of Technology, located in Shantou, Guangdong Province, China.

TUC has previously collaborated under the international Erasmus program with Institutions in Israel and Jordan. However, there has been no previous scientific collaboration between the applicant and the candidate H.E.I. The proposed action offers thus an excellent opportunity to establish a new long-term academic and research collaboration for the transfer of knowledge and skills between the [Applied Fluid Mechanics and Drilling Laboratory](#) at TUC (lead by Prof. Andreas Yiotis) and the [Thermofluids and Interfaces Laboratory at Technion](#) of Technion (led by Prof. Alexandros Terzis) given that there is a strong complementarity in the research methods and approaches between the two groups. Furthermore, Prof. Yiotis (TUC) and Prof. Terzis (Technion) have shared similar infrastructure during short scientific visits to the University of Stuttgart in 2019, working on different scientific projects. During these short interactions they have both identified common grounds for future collaborations, which they envision to realize through this project. While the Thermo-Fluids & Interfaces Laboratory has no previous experience in related projects, it has extensive international academic and research collaboration experience in eight countries worldwide (Israel, USA, Switzerland, Germany, China, Netherlands, England, Greece) with prominent academic institutions, including Stanford, the University of Stuttgart, the Shanghai Jiao Tong University and the University of Utrecht.

More specifically, the Applied Fluid Dynamics Laboratory of TUC has over 15 years of experience in the development and deployment of state-of-the-art methods for the modeling of multiphase flows in complex microscale geometries, such as membranes, geologic materials and microfluidic devices. It has dedicated access to state-of-the-art software developed by the group for the simulation of digital porous structures, such as Lattice Boltzmann for single and multiphase flows of Newtonian and Power Law fluids, Random Walk models, Stochastic Reconstruction and Process-based software for the development of digital porous structures, as well as commercially-available software, as COMSOL Multiphysics and ANSYS Fluent. High performance parallel computing approaches (MPI & OpenMP) and modern massively parallel supercomputers (Mare Nostrum in Spain, IDRIS in France, EPCC in the UK and ARIS in Greece) are used for the development of relevant numerical models.

This approach allows for the simulations of compute-intensive complex flows at unprecedented spatial resolution in confined spaces and heterogeneous materials, such as geologic porous media, membranes and microfluidic devices thus providing the required accurate microscale information required for upscaling at the continuum in order to calculate the apparent transport properties of porous media. The applications of this approach in relevant to energy conversion (e.g. transport of species in fuel cells), geologic flows (e.g. secondary hydrocarbon recovery) and novel environmental challenges (e.g. soil remediation and CO₂ sequestration) are used for soil remediation from insoluble and persistent anthropogenic pollutants, the geological storage of CO₂ in appropriate geologic structures and for climate change mitigation as a transitional technology towards a lower carbon energy sector and many others. While such processes are applied at large (geologic) scales ranging from meters to kilometers, the underlying dynamics of fluid-fluid interfaces emanate at the much finer pore and pore-network scale and is determined by a complex coupling between capillary, viscous and gravity forces. Such couplings may also include geochemical and geothermal interactions (a field relevant to the expertise of Prof. Terzis' group) that eventually produce highly non-linear flow dynamics that cannot be described by the established Darcy-scale approach in a physically consistent manner. The objective of this scientific and academic collaboration is to effectively address the relevant challenges of such field scale processes. The proposed mobility project is thus fully pertinent to the internationalization strategy of both partner Institutions that aims to tackle important engineering challenges of our times relevant to energy transition towards alternative and renewable technologies, the development of rigorous engineering solutions for climate change mitigation through carbon capture and storage and other engineering challenges for improving life quality.

The proposed flow mobility predicts in total 11 student mobilities from TUC to "Technion", 8 for Under graduates (4 for studies for 2 months each and 4 for traineeship for 2 months each), 2 for postgraduates (for

studies for 1 month each) and 1 for PhD student for 2 months. The proposed flow mobility predicts from “Technion” to TUC include in total 9 student mobilities, 4 for Undergraduates (2 for traineeship and 2 for combination of studies and traineeship), 4 for Postgraduates (2 for studies and 2 for traineeship) and 1 for PhD student for 2 months each. The proposed flow of staff mobility predicts 4 mobilities from TUC to “Technion” (2 for teaching for 5 days each and 2 for training for 10 days each) and 4 mobilities from “Technion” to TUC (2 for teaching and 2 for training) for 10 days each.

At the faculty level, the proposal envisions 4 short visits for each one of the Academic Advisors (i.e. Prof. Andreas Yiotis of TUC and Prof. Alexandros Terzis of “Technion”). These mobilities will be equally devoted to teaching and training period. While the primary focus will be on establishing a research collaboration through training, the teaching activities are also an integral part of this proposal that aims to offer unique opportunities to share teaching experiences and strategies, as well as to develop jointly novel educational which are suitable for the specific material that will be produced through this collaboration. At the under-graduate level, a total of 4 students from each partner is expected to participate in this exchange program. This estimation is based on the annual number of students that pursue a Diploma Thesis at the Applied Fluid Mechanics Lab each year, and more particularly on the those who pursue topics relevant to this collaboration. The students will be trained at Technion in modern visualization techniques, such as PIV, X-Ray micro-CT etc, as a part of their thesis at TUC.

Adherence to the principles of the Inter institutional Agreement and the required procedures before, during and after mobility have been pre-agreed in writing.

For “Technion”: Erasmus management officer: Mrs. Bat-el Almogy, Technion International Office, erasmus@technion.ac.il, +972-77-887-1883, Inclusion officer and Academic coordinator of Erasmus program: Mrs. Melinda Margulis, Dean of Students’ Office, visitors@technion.ac.il, +972-77-887-1948, Legal representative of the agreement: Atty. Efrat Sagi, Ben Ari, Fish, Saban & Co. Law Firm, Academic coordinator of Erasmus program at “Technion” Mrs. Melinda Margulis will contribute to the activities of 4 incoming students (1st cycle) for studies.

On the part of TUC, Academic coordinator of Erasmus program at MRED Prof. A. Gotsis will contribute to the activities of 2 incoming students (1st cycle). Professor Andreas Yiotis, Dr. Dimitrios Marinakis (Working team in Mineral Resources Engineering) and Dr. Eleftheria Antoniou (Working team in Applied Thermodynamics) of TUC have stated that they will co-supervise the dissertation of incoming students (2nd, 3rd cycle) and contribute to the activities of the 4 incoming staff members for teaching and training. Traineeship for Israeli students can take place at NCSR Demokritos and the Institute of GeoEnergy at FORTH

Professors A. Terzis of “Technion” have stated that they can co-supervise the dissertation of incoming students (2nd, 3rd cycle) and contribute to the activities of the 4 incoming staff members for teaching and training.

Erasmus officers of both Institutions have already been informed about the academic calendars. The recommended language skills for all participants are English/B2. Evaluation criteria of students at TUC and “Technion” are Academic merit, curriculum vitae and motivation to participate to the mobility. Criteria for evaluation of staff are the teaching and research experience and the activity plan.

C. IMPACT AND DISSEMINATION

Ερώτημα C (Σε επίπεδο ιδρύματος/20βαθμοί)

The main objective of the proposed action is to establish a long-term academic and scientific collaboration between two internationally acknowledged research groups in the general field of transport phenomena in porous materials; the research groups of Prof. Andreas Yiotis at TUC and of Prof. Alexandros Terzis at Technion. The TUC group has excellent experience in the development of theoretical and numerical models for the description of complex multiphase flows in microfluidic devices and porous materials, as evidenced by a strong track record in relevant scientific publications. The Technion group on the other hand has world leading experience in the experimental study of coupled heat, flow and mass transport processes in challenging

applications of significant applied interest in the fields of environment and engineering. The research of the Technion group is supported by state-of-the-art infrastructure, which is operated by expert technical personnel. The complimentary character of the proposed collaboration aims at bringing together the personnel and the affiliated students of the two groups in order to establish a very high-quality transfer of knowledge (and relevant skills) between them. More specifically, the knowledge of the TUC group in numerical modeling will be transferred towards the members of the Technion group, while the TUC group will benefit from the experiences and skills they will acquire in the experimental studies of the relevant processes. This complimentary collaboration is expected to have an important and measurable academic impact on the quality of the student training in both HEIs, but also produce high quality scientific results in the research field of transport process in porous media for environmental and energy applications.

1) Impact for exchange students: The proposed mobility action will be greatly beneficial for the students of both Institutions, as they will have an unprecedented opportunity to participate in the student life of TUC and Technion, one of the leading academic institutions in the middle East and the World in the field of Engineering. The students will have the opportunity to participate in lectures and courses by prominent members of both Institutions and obtain an insightful first-hand experience of diverse and different teaching and academic methods. These new academic experiences will offer them the opportunity to obtain new soft skills in academic communication, collaborating with multicultural teams in an international environment, preparing projects in English, among many other. The students will also be immersed in the research environment of Technion and TUC by receiving relevant training in the new experimental methodologies (PIV, X-Ray micro-ct etc) by the hosting group, thus greatly enhancing their research profiles and their future career perspectives, both in the academia but also in the engineering field.

2) Impact for academic staff: Through this collaboration Institutes aims to extent its expertise in the field of coupled microscale interactions by obtain much needed knowledge in relevant experimental methods that will greatly enhance its research potential in this field. The members of TUC's group will be thus trained in such state-of-the-art methods developing a solid expertise that will be transferred back and diffused at other Engineering Schools of TUC. On the other hand, the members of the Technion group will receive training during their visits at TUC in the development and deployment on modern modeling tools for the simulation of such complex processes. This unique two-way transfer of knowledge will be thus strongly beneficial for both parties by substantially extending and strengthening their research experiences.

3) Impact for the Universities: Through this collaboration with Technion, one of leading academic research and academic institutes in the world in the field of Engineering ranking 85th in the world (Shanghai Academic Ranking), TUC will greatly enhance its academic profile and recognition in the Middle East. The proposed collaboration will also enhance the academic profile of the TUC students that participate in the project, as they will exposed to the unique academic and institutional environment of Technion, through the variety of training and learning opportunities offered.

This will allow for the strengthening of its International Masters' Programmes with students coming from these countries, and for the establishment of new collaborations of its faculty members with Technion. Such collaboration will greatly enhance the potential of both Institutions to participate in international consortia and attract competitive research funding in the context of European and International Calls.

4) Impact for both counties: The proposed collaboration between TUC and Technion in the field of numerical and experimental studies of geologic multiphase flows relevant to environmental and energy applications will have a profound impact on the academic and teaching strategies of both HEIs. Besides the aforementioned expected research impact, this action is expected to lead to the development of common International courses in the field of "Transport Phenomena for Energy and Environmental Applications" which will be offered to both the undergraduate and postgraduate students of both HEIs in a hybrid format of physical and online teaching. For the latter purpose we aim to utilize digital teaching platforms, such as Zoon and Webex, both for delivering lectures, but also in order to encourage the international collaboration among students into smaller working groups. Such a hybrid inter-institutional academic approach will further strengthen the international

character of academia in Greece and could eventually lead to delivering joint academic programmes and bachelor and/or Master's degrees with Technion and other HEIs in the region.

5) International impact: The major aim of Erasmus+ International Credit Mobility Programme is internationalization, in the field of academia. Along with the strict academic benefits, the programme provides the opportunity to the related countries to develop cultural, economic and academic linkages and to all participants to dispose a refreshed approach to learning, teaching and administrating.

Also, the background of the involved Universities is suitable for contributing to the protection of the environment, by developing innovative practices in terms of sustainable engineering, all types of waste management with emphasis on energy production, integrated water resources management, etc. The digital transformation proposed through this ICM project is the key to successfully spread the information to the interested target groups around the world. It should be noticed that the involved students/academic staff/Universities of the proposed mobility/cooperation will actively participate on raising public awareness and influencing policies to promote harmonious relations and interaction between nations, despite the differences of cultural practices and beliefs.

Measures for the dissemination of the results at the level of Institutions: The collaboration between TUC and Technion will be first published at the website of the School of MRED, as well as on the central websites of both Institutions with regular news feeds regarding the particular collaboration, including available posts for students that wish to apply for mobility and news regarding experiences from on-going visits by the students. Institutes will communicate the job vacancies available at both partners and the important scientific outputs by staff meetings and webinars open to academic communities, and job vacancies available at both partners. The collaboration will also receive frequent and extensive coverage in the local news channels and press of Crete and Greece, which will be arranged by the Public Relations Office of TUC. Communication of the activities will be also pursued through the social media platforms (linkedin, facebook, twitter, Instagram) managed by the two student chapters of the School; the SPE SC and the SRES SC.

Measures for the dissemination of the results at the level of Countries: Regarding the dissemination of the results at national level, the following activities are scheduled: conferences/seminars/workshops/scientific events in collaboration with other Universities and educational-research Institutions, publications/press releases/media releases in local or national press/radio/TV in collaboration with scientific/environmental journalists, as well as posts on popular websites/forums of national range.

Measures for the dissemination of the results at international level: At international level, the results of the proposed Erasmus+ International Credit Mobility project will be disseminated through publications of articles in high-impact scientific international journals, and announcements in international conferences. Also, Technion and TUC will work together, but also with other relative Universities/Institutions worldwide, so to post the crucial results of their common research on scientific websites, giving the opportunity to the whole interested scientific community to have access to them.