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Faculty of Engineering

Department of Mining Engineering

Mineral Processing Group

M.Sc. & Ph.D. in Mineral Processing

M.Sc. in Mine & Environment

By: Dr. Sima Mohammadnejad

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Introduction

Mineral processing, is the art of processing ores and mineral products in order to separate the valuable minerals from the waste rock, or gangue. It is the first process that most ores endure after mining to provide a more concentrated material for the procedures of extractive metallurgy. In Iran and some other countries, this field also covers hydrometallurgy and electrometallurgy while in the rest of the world is enclosed in extractive metallurgy. Pyrometallurgy is usually under extractive metallurgy field of research and industry.

The group encompasses programs concerned with finding solutions for mineral processing industry challenges, process optimization, utilization of mineral resources and reducing the environmental impact of mineral processing plants.

The Mineral Processing group of Tarbiat Modares university was established in 1998 and since then average of 8-10 master students have been graduated annually and recruited by mineral processing industry all around the world after graduation. In 2006, the first Ph.D. student was admitted in this group and the course continued to be offered every two years. A new discipline of mining and environment was added in 2016 and students were admitted on average of 4-6 students per year. Master's theses and doctoral dissertations have often been published in the fields of hydrometallurgy, modeling and simulation of processes, flotation and concentration and purification of leach solutions and finally environmental evaluation of mineral processing operations. The results of some of them have also been used by industry. In 2018, the first Ph.D. student was admitted in mining and environment.

The group consistently ranked among the leading groups in the university in terms of research and education achievements. We are committed to responding to the major mineral processing and environmental challenges of mining industry in our country and all around the world. The group is strongly dedicated to supporting diversity and flexibility in the workplace, representing one of the rare mineral processing groups in the country with one female academic staff many M.Sc. and Ph.D. students. We are a medium size group with 6 full time academic staff, 3 laboratories, one lab manager around 40 M.Sc. and Ph.D. students. Industry engagement is the key focus, and we carry out research projects based on deep collaborations with government and private industry organization which support research projects of our students. Many of graduated students from this group play a vital role in societal progression of this field. There are three degrees given by this group:

- M.Sc. in Mineral Processing
- M.Sc. in Mine and Environment
- Ph.D. in Mineral Processing





Courses

1. M.Sc. in Mineral Processing
2. M.Sc. in Mine and Environment
3. Ph.D. in Mineral Processing

1. M.Sc. in Mineral Processing

Mineral processing master of engineering is a two-year program focusing on education in mineral ore concentration and hydrometallurgical related subjects. The program deals with all aspects of metal and non-metal processing and manufacturing to separate valuable minerals and metals from the ores. Mineral processing group of Tarbiat Modares University has unique academic staff graduated from top universities all around the world to provide an excellent infrastructure for training and education purposes.

Job skills

Job opportunities exist in all fields related to the mineral processing value chain including comminution, physical separation, flotation, hydrometallurgy, ... both in the industry and in research. The course has been aligned with industry needs and you'll be prepared for a career in a variety of multi-disciplinary roles across the sector.

Syllabus

The total number of education and research credits to be earned in order to obtain a TMU M.Sc. in mineral processing engineering is 32 including 12 compulsory and 12 optional to be determined by the supervisor based on the student background. The number of research credit is 2 for seminar and 6 for the thesis (Table 1).

Table 1. Units and credits for M.Sc. students in mineral processing

Units	Credits
Compulsory	12
Optional	12
Seminar	2
Thesis	6
Total	32

Compensatory Units

The maximum number of compensatory units is 6 according to the following table. The compensatory units are not included in the required number of credits to be earned by M.Sc. student and are offered by the group based on the passed units in the bachelor degree of students.

Table 2. Compensatory lecture and lab units for M.Sc. students in mineral processing

Course	Units	Lecture unit	Lab Unit	Type of unit	Number of hours
Flotation	2	2	---	Lecture	32
Flotation Lab	1	---	1	Lab	32
Hydrometallurgy principles and lab	3	2	1	Lecture-lab	64
Descriptive mineralogy	2	2	---	Lecture	32
Petrology	2	2	---	Lecture	32
Mineral processing principles	2	2	---	Lecture	32
Mineral processing principles lab	1	---	1	Lab	32

Compulsory units

The list of compulsory units has been presented in Table 3. M.Sc. students in mineral processing must take 12 units from this list.

Table 3. Compulsory lecture and lab units for M.Sc. students in mineral processing

Course	Units	Lecture unit	Lab Unit	Type of unit	Number of hours
Advanced flotation	2	2	---	Lecture	32
Advanced mineral processing	2	2	---	Lecture	32
Modelling, simulation and principles of control in mineral processing systems	3	3	---	Lecture	48
Advanced hydrometallurgy	3	3	---	Lecture	48
Advanced comminution	2	2	---	Lecture	32

Optional units

The list of optional units to be selected and earned at least 12 credits by M.Sc. students in mineral processing are as follows.

Table 4. Optional lecture and lab units for M.Sc. students in mineral processing

Course	Units		Course	Units
1 Process Mineralogy	2	11	Slime processing	2
2 Nonmetallic minerals processing	2	12	Rare earth and radioactive elements processing	2
3 Mineral processing and environment	2	13	Advances in mineral processing equipment	2
4 Concentration and purification of leach solutions	2	14	Ethics in engineering	2
5 Design and analysis of Experiments	2	15	Electrometallurgy	2
6 Surface phenomena	2	16	Mineral processing plant design	2
7 Tailing and waste management and recovery	2	17	Advanced mathematics	3
8 Biotechnology in mineral processing	2	18	Mass and heat transfer	2
9 Nanotechnology in mineral processing	2	19	Special topics	2
10 Metal or metal compound extraction from solutions	2			

2. M.Sc. in Mine and Environment

The specific focus of the program and specialist expertise provided will be centered on environmental aspects of mining engineering. Students will be provided with a multi-disciplinary skillset covering natural, engineering and social science aspects of mining environmental management.

The course is based on a robust understanding of scientific and social science theory in the field of mining environmental management, and the practice and application of field, laboratory and computing skills. Students will gain experience in acquiring, synthesizing and critically evaluating data from a range of geochemical, mineralogical, remote sensing and social science databases.

The program is delivered through a mix of lectures, workshops, tutorials, practical activities, case studies, industry visits, computer simulations, project work and a dissertation. Field visits and practical field-based assignments are used, where appropriate, to emphasize key areas within each module. The taught part of the program is structured into two semesters with one-year research work.

Job skills:

Graduates of this field can involve in research, executive and specialized projects in various fields of mining environment, including hydrological and hydrogeological challenges of mines, design of landfills, tailings management, mine rehabilitation and environmental impact assessment of mine projects.

Syllabus:

The total number of education and research credits to be earned in order to obtain a TMU M.Sc. in mineral processing engineering is 32 including 12 compulsory and 12 optional to be determined by the supervisor based on the student background. The number of research credit is 8, 2 for seminar and 6 for the thesis.

Table 5. Units and credits for M.Sc. students in mine and environment

Units	Credits
Compulsory	12
Optional	12
Seminar	2
Thesis	6
Total	32

Compensatory Units

The maximum number of compensatory units is 6 according to the following table. The compensatory units are not included in the required number of credits to be earned by M.Sc. student and are offered by the group based on the passed units in the bachelor degree of students.

Table 6. Compensatory lecture and lab units for M.Sc. students in mine and environment

	Course	Units
1	Underground waters	2
2	Mineral processing (principles)	2
3	Mineral exploration principles	2
4	Mineral exploitation principles	2
5	Rock mechanics principles	2
6	Safety, health and environment	2
7	Mine ventilation	2

Compulsory units

The list of compulsory units has been presented in Table 7. M.Sc. students in mine and environment must take 12 units from this list.

Table 7. Compulsory lecture and lab units for M.Sc. students in mineral processing

Number	Unit name	Number of units
1	Mine rehabilitation	3
2	Advanced mine environment	3
Two units from four following units must be taken by group advice		
3	Environmental impact assessment (EIA) of mine projects	3
4	Treatment, processing and controlling of mining wastes	3
5	Mass conversion transfer processing and model	3
6	Environmental geochemistry	3
Total		12

Optional units

The list of optional units to be selected and earned at least 12 credits by M.Sc. students in mine and environment are as follows.

Table 8. Optional lecture and lab units for M.Sc. students in mine and environment

Number	Unit name	Number of units
1	Advanced hydrometallurgy	3
2	Mining tailing management	2
3	Environmental geophysics	2
4	Nanotechnology in mining environment	2
5	Biotechnology in mining environment	2
6	Hydrogeology	2

7	Waste and waste systems management	2
8	Risk management in mining	2
9	GIS application in environment	2
10	Oil pollution	2
11	Geomechanics and environment	2
12	Modelling in mining environment	2
13	Numerical methods	2
14	Hazardous waste characterization and control	2
15	Geostatistics	2
16	Air pollution	3
17	Surface and underground water pollution	3

3. Ph.D. in Mineral Processing

Ph.D. degree in mineral processing is the highest level in this field which has been designated for passionate researchers with a strong desire to contribute to innovation in the minerals processing field. The program consists of two semester of lecture units as well as a two years research program. The research conducted will be supervised by expert faculty and must result in a doctoral thesis that provides significant contribution to the field of study.

The aim of the Ph.D. program in mineral processing based on literature and previous studies are:

- Learning advanced research methods to innovate
- Experiencing novel scientific, research methodology and technology
- Innovation in edge of science of this field
- Mastering one or few capabilities of research and development programming. Evaluation and supervision, scientific problems analysis

The program includes two education and research parts. In education part, students must take 12-18 units different from their passed units in M.Sc. degree (Table

Table 9. The list and number of units for Ph.D. students in mineral processing

Units	Credits
Number of units from Ph.D. optional units table	Min 6
Number of units from graduate optional units table	Max 12
Total number	12-18

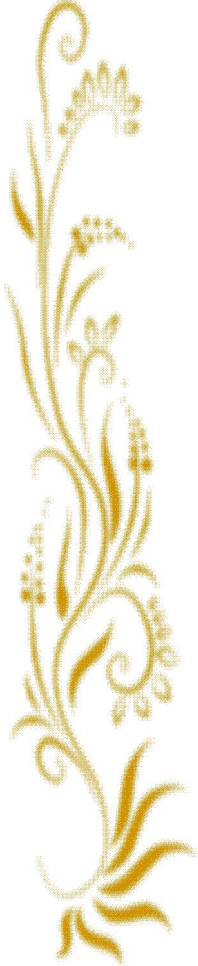
Student must select his/her supervisor in the first semester. In this time, candidates may choose to follow a specific orientation in taking their modules and later, in writing their theses, under supervision of principal supervisor. The Ph.D. program takes up to four years, with possibility of extension for a fifth year if necessary. During the first two years, students will pass 12-18 units in total. After successfully passing all course requirements as well as a comprehensive exam, students will be required to write an extensive Ph.D. thesis on a subject of their own interest related to mineral processing significant challenges. This research project will be supervised by at least two faculty members including 18-24, and must be defended before a board of examiners.

Optional units

The list of optional units to be selected and earned at least 6 credits by Ph.D. students in mineral processing as follows.

Table 10. Optional lecture for Ph.D. students in mineral processing (all lecture units)

Number	Unit name	Number of units
1	Solution chemistry	3
2	Advanced modeling and simulation in mineral processing systems	3
3	Control and disposal of mine wastes and wastewaters	3
4	Industrial management in mines and mineral processing plants	3
5	Electrochemistry in mineral processing	3
6	Control of mineral processing systems	3
7	Seminar 1	1
8	Seminar 2	1



Academic Staff and Research Areas

Mine & Environment

1. Dr. Ahmad Khodadadi Darban
2. Dr. Ahmad Jamshidi
3. Dr. Mehdi Homaee

Mineral Processing

1. Dr. Mahmoud Abdollahy
2. Dr. Mohammadreza Khalesi
3. Dr. Sima Mohammadnejad
4. Dr. Mahdi Mohseni

Dr. Mahmoud Abdollahy

Faculty manager



Professor

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Bibliography

Mahmoud Abdollahy is professor of Mineral Processing, holds a M.Sc. degree in Mining exploitation from Tehran University (1987) and a Ph.D. degree from Leeds University, UK (1996). He is teaching Flotation, Advanced Flotation, mineral processing and concentration & purification of leach Solutions for M.Sc. students and chemistry of solution for Ph.D. students at Mineral processing group.

Education

- Ph.D. 1996 Mineral Processing, Mining, Leeds, UK
- M.Sc. 1987 Mining engineering, University of Tehran

Teaching Units

M.Sc. program

- Advanced mineral processing
- Concentration and purification of leach solutions

Ph.D. program

- Solution chemistry

Research Areas:

- Hydrometallurgy
- Flotation

Dr. Ahmad Khodadadi Darban



Professor

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Dr. Khodadadi Darban is a full professor of mine and environment since 2001 at TMU. He holds a Ph.D. degree in geo environmental engineering and a M.Sc. in civil engineering from Canadian universities. With his long experience in research and education in the field of mining environment, he is a valuable asset for the mineral processing group.

Education:

- Ph.D. 1998, Geo environmental Engineering, Civil, Montreal, Montreal, Canada
- M.Sc. 1994, Civil Engineering, Civil Engineering, Carlton, Ottawa, Canada

Research Areas:

- Mine and environment
- Soil and water pollution and mining wastewater treatment

Dr. Mohammad Reza Khalesi



Associate Professor

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Dr Mohammad Reza Khalesi, born in Tehran, 1977, is a graduate of University of Tehran in Mining exploration (B.Sc.) and Mineral processing (M.Sc.) and hold a Ph.D. in material and metallurgy from Laval University, Canada. He is a member of Iranian Society of Mining Engineering (vice president from 2016 to 2019) and a member of Canadian Institute of Mining, Metallurgy and Petroleum (CIM) from 2005. He is mostly focused on modeling, optimization and control of mineral processing and extractive metallurgy systems.

Education:

- Ph.D. 2010, Metallurgy and Materials Engineering, Laval University, Quebec, Canada
- M.Sc. 2001, Mining Engineering - Mineral Processing, University of Tehran, Iran
- B.Sc. 1999, Mining engineering, Mining exploration, University of Tehran, Iran

Teaching Units

M.Sc. program

- Modelling, simulation and principles of control in mineral processing systems
- Experiment design and analysis
- Expert systems and artificial intelligence in mining engineering

Ph.D. program

- Control of mineral processing systems
- Advanced modeling and simulation in mineral processing

Research Areas:

- Control of mineral processing and extractive metallurgy systems
- Modeling, simulation and optimization of mineral processing and extractive metallurgy systems

Dr. Ahmad Jamshidi Zanjani

Group manager



Assistant Professor

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Ahmad Jamshidi Zanjani is assistant professor of mine and environment since 2015. He has his Ph.D. from Iran university of Science and Technology (IUST) in Civil Engineering-Environmental Engineering in 2013.

Education:

- Ph.D. 2013 Civil Engineering - Environmental Engineering, Iran University of Science and Technology
- M.Sc. 2008 Civil Engineering - Environmental Engineering, Iran University of Science and Technology
- BSc 2005 Civil Engineering - Civil Engineering, Isfahan University of Technology

Research Areas:

- Municipal and Mining waste management
- Water and Soil remediation
- Contaminant fate and transfer

Dr. Sima Mohammadnejad



Assistant Professor

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Dr. Sima Mohammadnejad is a process mineralogist and hydro metallurgist with 15 years of academic and industrial experience in Iran, Australia and Turkey. She holds a Ph.D. degree in Mineral Processing Engineering, 2014 University of Melbourne-Australia and M.Sc. of Mineral Processing, 2007, Tehran University and B.Sc. of Mining Engineering, 2003, Amir Kabir University.

Education:

- Ph.D. 2014, Chemistry, Mineral Processing, Melbourne,
- M.Sc. 2005, Mineral Processing, Mining, Tehran
- B.Sc. 2001, Mining, Amir Kabir University, Tehran

Teaching Units

- Advanced hydrometallurgy
- Process Mineralogy
- Mineral processing plant design

Research Areas:

- Hydrometallurgy of precious metals and metals
- Molecular Modeling in mineral processing
- Process Mineralogy

Dr. Mehdi Mohseni



Assistant Professor

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Dr. Mehdi Mohseni is an assistant professor of Mineral Processing at Tarbiat Modares University. He holds a B.Sc. degree in Mining exploitation from Sahand University of technology (2008) and a M.Sc. degree in Mineral Processing from Tarbiat Modares University (2011) and a Ph.D. degree in Mineral Processing from Tarbiat Modares University (2017). Flotation science technology and processing the metallic and industrial minerals are his research and practical interest.

Education:

- Ph.D. 2017, Mineral Processing, Mining Engineering, Tarbiat Modares University, Tehran
- M.Sc. 2011, Mineral Processing, Mining Engineering, Tarbiat Modares University, Tehran
- B.Sc. 2008, Mining Exploitation, Mining Engineering, Sahand University of Technology, Tabriz

Teaching Units

- Flotation
- Flotation Lab
- Advanced flotation
- Advanced comminution
- Nonmetallic minerals processing

Research Areas:

- Flotation and Mineral Surface chemistry
- Processing of Metallic and Industrial Mineral Resources



Research Areas

Research Areas

Our research covers the spectrum – from linguistics to control to water and soil pollution faces of mineral processing operations. Our breadth of expertise across our faculties and schools is supported by deep disciplinary knowledge. We have significant capability in more than 20 major areas of research.

Major research areas

Mahmoud Abdollahy (Professor)

1. Hydrometallurgy
2. Flotation

Ahmad Khodadadi Darban (Professor)

3. Mine and environment
4. Soil and water pollution and mine waste recycling, remediation and mine wastewater treatment

Mohammad Reza Khalesi (Associate Professor)

5. Control of mineral processing and extractive metallurgy systems
6. Modeling, simulation and optimization of mineral processing and extractive metallurgy systems
7. Gold processing

Ahmad Jamshidi Zanjani (Assistant Professor)

8. Mine and environment
9. Soil and water pollution and mining wastewater treatment, Mine waste management

Sima Mohammadnejad (Assistant Professor)

10. Hydrometallurgy of precious metals
11. Molecular modeling in mineral processing
12. Process mineralogy

Mehdi Mohseni (Assistant Professor)

13. Flotation and Mineral surface chemistry
14. Processing of metallic and industrial mineral resources



Curriculum

Curriculum

The academic curriculum in our group is based on approved syllabus by the Ministry of Science, with courses derived from the academic staff areas of expertise. As research responds to innovation and change, so courses follow the same trend. However, the programs are flexible enough to respond to a variety of other influences on the curriculum, via optional units.

First semester

M.Sc. of Mineral Processing

Number	Unit name	Unit number	Lecturer	Weekly program
1	Advanced hydrometallurgy	3	Mohammadnejad	Monday: 15-16:30 Wednesday: 15-16:30
2	Mineral processing & environment	2	Khodadadi	Wednesday: 13:30-15
3	Flotation	2	Mohseni	Monday: 11:12:30
4	Flotation lab	1	Mohseni	Monday: 16:30-18
5	Advanced mineral processing	2	Abdollahy	Wednesday: 11:12:30
6	Modeling, simulation and principles of control in mineral processing systems	3	Khalesi	Monday: 9:30-11 Tuesday: 9:30-11
7	Advanced comminution	2	Mohseni	Tuesday: 15:16:30

M.Sc. of Mine and Environment

Number	Unit name	Unit number	Lecturer	Weekly program
1	Advanced environment in mining	3	Khodadadi	Sunday: 15-16:30 Tuesday: 15-16:230
2	Environmental geochemistry	3	Jamshidi	Sunday: 13:30-15 Tuesday: 13:30-15
3	Hydrogeology	2	Guest lecturer	Sunday: 7:30-9:30
4	Advanced hydrometallurgy	3	Mohammadnejad	Monday: 15-16:30 Wednesday: 15-16:30
5	Flotation	2	Mohseni	Monday: 11:12:30

Ph.D. of Mineral Processing

Number	Unit name	Unit number	Lecturer	Weekly program
1	Solution chemistry	3	Abdollahy	Tuesday: 1-12:30 Wednesday: 9:30-11
2	Advanced Modeling & simulation in mineral processing systems	3	Khalesi	Monday: 13:30-15 Tuesday: 15-16:30

Second semester

M.Sc. of Mineral Processing

Number	Unit name	Unit number	Lecturer	Weekly program
1	Advanced flotation	2	Mohseni	Wednesday: 9:30-11
2	Process mineralogy		Mohammadnejad	Wednesday: 13:30-15
3	Mineral processing plant design		Mohammadnejad	Tuesday: 13:30-15
4	Concentration and purification of leach solutions	2	Abdollahy	
5	Design and analysis of experiments	2	Khalesi	
6	Nonmetallic minerals processing	2	Mohseni	

M.Sc. of Mine and Environment

Number	Unit name	Unit number	Lecturer	Weekly program
1	Mine rehabilitation	3	Khodadadi	Sunday: 15-16:30
2	Design and analysis of experiments	2	Khalesi	Sunday: 13:30-15 Tuesday: 13:30-15
3	Environmental Impact assessment	3	Jamshidi	Sunday: 7:30-9:30
4	Mass conversion transfer processing and modeling	3	Guest lecturer	Variable

Ph.D. of Mineral Processing

Number	Unit name	Unit number	Lecturer	Weekly program
1	Tailing and waste management and recovery	2	Khodadi	Variable
2	Special topics	3	Variable	Variable
3	Special topics	3	Variable	Variable

