University of Tripoli
Faculty of Engineering

MATERIALS AND METALLURGICAL ENGINEERING DEPARTMENT
Graduate programs

General Information

The field of materials engineering focuses on subjects that study the relationship between structure of materials (ranging from macro to nano-scale) and their properties (mechanical, thermal, electrical,…..etc). In this context, the field involves the development and modification of engineering materials to meet the desired properties demanded by modern industrial and societal needs.

In the University of Tripoli, the existing Materials and Metallurgical Engineering (MME) department was established in 1978 as one of the departments in Faculty of Nuclear and Electronic Engineering under name of Materials Science and Engineering (MSE). It was then joined with Metallurgical Engineering Department, which was in existence since 1972 as one of the departments in Faculty of Petroleum and Mining Engineering.

Since 1978, the subjects taught were designed to prepare future bachelor degree materials engineers equipped with an intermixed knowledge in metals and nonmetals (mainly polymers and ceramics). In 1993 the department initiated a graduate program that offers advanced courses and research work to obtain a Master's of Science (M.Sc.) degree in Materials. The student in MME Masters Program takes advanced courses composing of one or two general graduate courses of advanced engineering mathematics, advanced numerical methods in engineering, or advanced statistics and computer methods. He or she then takes 6 to 7 additional MME departmental courses, and engages in a 2-semester research project related to subjects that deal with modern materials engineering problems.

As only one of materials oriented programs in the country, MME Masters Program was able to graduate well qualified engineers that either pursued their higher university studies abroad or engaged in research establishments in the country.

Vision

- Integrate the fundamental principles of chemistry, physics, and mathematics in materials and metallurgical engineering courses,

- Create new opportunities in materials failure analysis, nanotechnology, photovoltaic and other engineering applications,
- Working alongside with industry to solve processing problems and to meet current and future manufacturing needs.

Mission

- Equip students with advanced comprehensive knowledge of materials engineering and related technologies,
- Understanding of structure-property relations to assist optimum materials selection for the intended applications
- Teach scientific research skills.

Programs

The M.Sc. degree in graduate program in the Materials and Metallurgical Engineering Department requires a minimum of 24 credits of courses, one credit of graduate seminar, and 6 credits for thesis with a total of 31 credits. Of these, the M.Sc. student can take a minimum of five elective courses in an intermixed fashion from metals and their alloys, ceramics, and polymers offered courses. The student can also orient his/her degree in one of the selected branches (metals, polymer, or ceramics) by choosing his/her 15 credit elective courses in one of these branches.

Admission to the materials and metallurgical engineering masters program is through the standard graduate admission process of the University of Tripoli. The typical duration of the program is 36 months. A grade of C or better must be achieved in each course to obtain credit. An overall grade point average of at least 3.0 must be maintained each semester until the completion of program.

Program I

PROGRAM	***Metals Engineering***
DEGREE	Master of Science (M. Sc.)
OBJECTIVES	1. The M.Sc. of Metals Branch program aims to provide the postgraduate student with advanced knowledge of the science and engineering of metallic materials and their alloys. 2. Courses are designed to cover most recent trends in the application of metals and their alloys and to present advanced levels for fundamental courses. 3. M.Sc. graduates should be capable of involving in materials selection, failure analysis, design of new materials, materials component processing and manufacturing, and quality assurance & environmental control.

Code	Title	Credits	Hours	ECTS
Faculty Requirements (3 credits)				
GE604	Advanced Engineering Mathematics	3	4	8
GE606	Applied Statistics and Computer Application	3	4	8
GE609	Numerical Methods in Engineering	3	4	8
Department Requirements (6 credits)				
MME612	Advanced Metallurgical Thermodynamics	3	4	8
MME624	Characterization of Materials	3	4	8
Elective courses (16 credits)				
MME620	Phase Transformation in Metals and Alloys	3	4	8
MME621	Structure of Metals	3	4	8
MME622	Physical Metallurgy of Steels	3	4	8
MME623	Physical Metallurgy of Light Metals and Alloys	3	4	8
MME650	Advanced Materials Processing	3	4	8
MME651	Advanced Topics in Corrosion	3	4	8
MME671	Crystal Growth	3	4	8
MME672	Thin Film Techniques	3	4	8
MME673	Superconducting Materials	3	4	8
MME674	Magnetic Materials	3	4	8
MME675	Solar Energy Materials	3	4	8
MME676	Composite Materials	3	4	8
MME690	Welding Metallurgy	3	4	8
MME691	Advanced Casting	3	4	8
MME692	Advanced Mechanical Metallurgy	3	4	8
MME693	Wear and Oxidation of Metals	3	4	8
MME697	Special Topics	3	4	8

MME698	Graduate Seminar **	1	2	10
Thesis (6 Credits)				
MME699	M.Sc. Thesis	6	0	50
Total		**31**	**0**	**124**

*** Mandatory Courses* *ECTS: European Credit Transfer and Accumulation System*

Program II

PROGRAM	***Polymers Engineering***
DEGREE	Master of Science (M. Sc.)
OBJECTIVES	1. The M.Sc. of Polymers Branch program aims to provide the postgraduate student with advanced knowledge in the science and engineering of polymeric materials. 2. Courses are designed to cover most recent trends in polymeric materials application and to present advanced levels for fundamental courses. 3. M.Sc. graduates should be capable of involving in polymeric materials utilization, synthesis, design of new materials, materials component processing and manufacturing, and quality assurance & environmental control.

Code	*Title*	*Credits*	*Hours*	*ECTS*
Faculty Requirements (3 credits)				
GE604	Advanced Engineering Mathematics	3	4	8
GE606	Applied Statistics and Computer Application	3	4	8
GE609	Numerical Methods in Engineering	3	4	8
Department Requirements (6 credits)				
MME612	Advanced Metallurgical Thermodynamics	3	4	8
MME624	Characterization of Materials	3	4	8
Elective courses (16 credits)				
MME650	Advanced Materials Processing	3	4	8
MME670	Structure and Properties of Semiconductors and Dielectrics	3	4	8
MME671	Crystal Growth	3	4	8
MME672	Thin Film Techniques	3	4	8
MME673	Superconducting Materials	3	4	8
MME674	Magnetic Materials	3	4	8
MME675	Solar Energy Materials	3	4	8
MME676	Composite Materials	3	4	8
MME680	Structure and Properties of Polymers	3	4	8
MME690	Welding Metallurgy	3	4	8

MME691	Advanced Casting	3	4	8
MME692	Advanced Mechanical Metallurgy	3	4	8
MME697	Special Topics	3	4	8
MME698	Graduate Seminar **	1	2	10
Thesis (6 Credits)				
MME699	M.Sc. Thesis	6	0	50
Total		31	0	124

*** Mandatory Courses* *ECTS: European Credit Transfer and Accumulation System*

Program III

PROGRAM	***Ceramic Engineering***
DEGREE	Master of Science (M. Sc.)
OBJECTIVES	1- The M.Sc. of Ceramic Branch program aims to provide the postgraduate student with advanced knowledge in the science and engineering field of ceramic materials. 2 Courses are designed to cover most recent trends in ceramic materials application and to present advanced levels for fundamental courses. 2- M.Sc. graduates should be capable of involving in ceramic materials utilization, synthesis, design of new materials, materials component processing and manufacturing, and quality assurance & environmental control.

Code	Title	Credits	Hours	ECTS
Faculty Requirements (3 credits)				
GE604	Advanced Engineering Mathematics	3	4	8
GE606	Applied Statistics and Computer Application	3	4	8
GE609	Numerical Methods in Engineering	3	4	8
Department Requirements (6 credits)				
MME612	Advanced Metallurgical Thermodynamics	3	4	8
MME624	Characterization of Materials	3	4	8
Elective courses (16 credits)				
MME650	Advanced Materials Processing	3	4	8
MME660	The Formation and Structure of Glass	3	4	8
MME661	Physical Properties of Ceramic Materials" Measurement & Testing"	3	4	8
MME670	Structure and Properties of Semiconductors and Dielectrics	3	4	8
MME671	Crystal Growth	3	4	8
MME672	Thin Film Techniques	3	4	8
MME673	Superconducting Materials	3	4	8
MME674	Magnetic Materials	3	4	8

MME675	Solar Energy Materials	3	4	8
MME676	Composite Materials	3	4	8
MME690	Welding Metallurgy	3	4	8
MME691	Advanced Casting	3	4	8
MME692	Advanced Mechanical Metallurgy	3	4	8
MME697	Special Topics	3	4	8
MME698	Graduate Seminar **	1	2	10
Thesis (6 Credits)				
MME699	M.Sc. Thesis	6	0	50
Total		31	0	124

** * Mandatory Courses* *ECTS: European Credit Transfer and Accumulation System*

Description of the Graduate Courses

- *General Courses*

GE604 Advanced Engineering Mathematics (3 *Credits* – 4 Hours)

Review of ordinary differential equations; linear differential equation of the first order; linear differential equations with constant coefficients; particular solutions by variations of parameters. Power series solutions; method of Frobenius; Legendre's equation; Fourier-Legendre Series; Bessel's equation; modified Bessel equation. Fourier methods; Fourier series; Sturm-Liouville theory; Fourier integral; Fourier transformation. Partial differential equations; heat conduction equation; separation of variables; waves and vibrations in strings; wave equation; D'Alembert's solution; longitudinal vibrations in an elastic rod; two dimensional stress systems; solution of Navier's equations by the application of Fourier transforms; Laplace equation.

GE606 Applied Statistics and Computer Application *(3 Credits – 4 Hours)*

Random variables; common discrete, continuous expectations and their applications; Sampling of the mean, hypothesis testing of the mean and variance, confidence intervals and Chi-Square procedures; Simple linear regression and correlation; precision and straight line fits; Matrix approach; multiple; Linear regression; polynomial and extra sum of squares in linear regression analysis; Transformation, weighted dummy variables and special topics in multiple regression analysis; Selecting the best regression model; Design of experiments; Single-factor and Multi-factor analysis of variance. Application of Statistical software packages such as: MINITAB, SPSS, etc.…

GE609 Numerical Methods in Engineering (3 *Credits* – 4 Hours)

Interpolation; Linear interpolation, Lagrange and Aitkin's interpolating polynomials, Difference calculus, Newton forward and backward difference formula, curve fittings, least square approximations, Fitting nonlinear curves, Cubic spline, Chebyshev polynomials, Approximation with rational function ordinary differential equations, Analytical and computer-aided solutions, Boundary conditions, Taylor series method.

- *Department Courses*

MME612 Advanced Metallurgical Thermodynamics *(3 Credits – 4 Hours)*

Advanced topics in thermodynamics as applied to metallurgy. Topics include solutions, defect chemistry, multi-component systems, thermodynamics of surfaces and interfaces, phase transformations and modeling of thermodynamic systems.

MME624 Characterization of Materials *(3 Credits – 4 Hours)*

Lectures and laboratory experiences on both new and established techniques for microstructural characterizations of materials. Techniques include TEM, SEM, X-ray and electron diffraction, EDS and EELS.

MME620 Phase Transformations in Metals and Alloys *(3 Credits – 4 Hours)*

The theory of different types of solid-solid phase transformations will be discussed in detail and the applicability to different metallic systems.

MME621 Structure of Metals *(3 Credits – 4 Hours)*

Study of structure of solid solutions, intermediate phases and superlatices. Theory of metallic phases. Defect measurements by diffraction, stress measurements by x-rays and other related topics.

MME622 Physical Metallurgy of Steels *(3 Credits – 4 Hours)*

Structural defects in iron, plastic deformation in iron single and polycrystalline materials, effect of alloying elements in solid solutions, effect of second phase formations, heat treatment, high strength, tool and environmental steels, segregation, surface hardening techniques, tempering, ageing .

MME623 Physical Metallurgy of Light Metals and Alloys *(3 Credits – 4 Hours)*

Aluminum and its alloys, Mg-base alloys, Be-base alloys, Ti and its alloys, structure, heat treatment and properties.

MME650 Advanced Materials Processing *(3 Credits – 4 Hours)*

This course will focus on primary processing of ferrous and nonferrous metals and their alloys, semiconductor processing, single crystal growth of Si, GaAs, thin film processing (physical and chemical vapour deposition), processing of advanced nanostructures such as nanoparticles, nanowires, nanotubes, graphene. In addition this course will cover sustainable materials processing.

MME651 Advanced Topics in Corrosion *(3 Credits – 4 Hours)*

Sour gas corrosion, sweet gas corrosion, corrosion in concrete, cathodic protection systems design and advanced topics in corrosion of high temperature materials.

MME660 The Formation and Structure of Glass *(3 Credits – 4 Hours)*

Glass formation, transition, structure and composition. Kinetic theory of glass formation. Properties of glass melts. Mechanical, thermal, electrical, electrical and optical properties of commercial silicate glasses. Glass-ceramics, their making, properties and applications. Glass reuse and recycling.

MME661 Physical Properties of Ceramic Materials" Measurements and Testing" *(3 Credits – 4 Hours)*

Physical and thermal properties and their tests and measurements, mechanical behavior and testing, electrical properties and their measuring, dielectric, magnetic and optical behavior, effect of time, temperature and environment on properties.

MME670 Structure and Properties of Semiconductors and Dielectrics *(3 Credits – 4 Hours)*

Materials as related to interatomic bonding and crystal structure. Diffusion in semiconductors and defect specifics, electrophysical properties of semiconductors and dielectrics, dielectric breakdown, polycrystalline and amorphous semiconductors.

MME671 Crystal Growth *(3 Credits – 4 Hours)*

Theories and techniques of growing crystals from solutions and melts, from vapor state. Recrystallization techniques, hydrothermal and related techniques. Growing crystals of refractory materials, methods of control of growth parameters.

MME672 Thin Film Techniques *(3 Credits – 4 Hours)*

The theory and practice of thin film production by various techniques including vacuum deposition, chemical deposition, sputtering, epitaxy,…etc. Methods of measuring thin film parameters and properties, monitoring of structural changes in thin films.

MME673 Superconducting Materials *(3 Credits – 4 Hours)*

Theoretical aspects of the superconducting state in metallic and oxide systems, measuring parameters of superconductors, structure of superconductors, preparation and property determination, applications and performance.

MME674 Magnetic Materials *(3 Credits – 4 Hours)*

Theories of various magnetic states, soft and hard magnetic materials, ferrites, materials for magneto-optics, preparation of magnetic crystals and thin films, magneto-optical media.

MME675 Energy Materials *(3 Credits – 4 Hours)*

This course is a materials science approach to the challenge of energy-efficient technology. It introduces the concept of materials energy content (production, processing, use, and recycling), description of how advanced materials make possible efficient energy harvesting (e.g., solar cells, nuclear materials, hard materials for oil/gas recovery, composites for wind energy, thermoelectrics), energy transformation (e.g., fuel cells, light emitting diodes, engines and turbines) and energy storage (e.g., hydrogen storage, phase change materials). Finally, materials enabling energy-efficient transportation and housing are discussed.

MME675 Composite Materials *(3 Credits – 4 Hours)*

Review of all classes of engineering materials, composite fabrication methods, structure and properties of composite materials, fibers, resin-matrix, metal-matrix , and ceramic-matrix composites, Macro and micro mechanical behavior of composites, physical-mechanical-nondestructive characterization techniques.

MME680 Structure and Properties of Polymers *(3 Credits – 4 Hours)*

Recent developments in polymer science, relationship between molecular structure, morphology and properties, design of polymers to fulfill special functions, high modulus fibers, non-linear optical properties, conducting polymers and resins for composite materials.

MME690 Welding Metallurgy *(3 Credits – 4 Hours)*

Fusion welding processes, heat flow in welds, Weld thermal cycle, Metallurgy of fusion welds in: work-hardened metals and alloys, precipitation-hardening materials, transformation hardening materials

MME691 Advanced Casting *(3 Credits – 4 Hours)*

Solidification in metals, solid solutions and eutectic alloys, control of structure and grain size, advances in pattern and core production, advanced casting techniques, specifics in casting of aluminum-, magnesium-, copper-, nickel-base alloys, steels and cast irons, solidification control techniques, advances in casting design, inspection and control in foundry practice.

MME692 Advanced Mechanical Metallurgy *(3 Credits – 4 Hours)*

Advances in the theory of plastic deformation of materials, theories of brittle and ductile fracture, fatigue in different metallic systems, creep theories and their application in heat resisting materials, effect of bonding and type of microstructure on flow behavior and fracture.

MME693 Wear and Oxidation of Metals *(3 Credits – 4 Hours)*

Recent theories of adhesive and abrasive wear effects of environment, theories of lubrication, combined effects of wear and oxidation, high temperature oxidation of metals and alloys, effect of environments, wear and oxidation in cement industry, other engineering problems, wear prevention.

MME697 Special Topics (3 Credits – 4 Hours)

The topics are not listed in department programs and may vary from year to year according to interests of students and instructors.
M.S. students choose and study a topic under the guidance of the department coordinator. Typical contents include advanced fields of study according to recent scientific and technological developments in the related areas. Also, it could be studied from other related departments after getting the permission.

MME698 Graduate Seminar (1 Credits - 2 Hours)

This course help students to develop their research proposals, establishing and expanding their research skills and implementing their work through scholarly writing, which can be achieved through the seminar.
The seminar course must to be taken in the second semester of the registration and managed by an instructor who is responsible to prepare the final grade list of all the registered students.
Students must prepare and present their chosen topics through a scientific term paper, which can be shared and discussed with other students and department staff to gain their feedback.

MME699 M.Sc. Thesis (6 Credits)

- ***Learning objectives outcomes***

Postgraduate materials and science students will demonstrate an ability to:

1-Idendify, formulate and solve materials engineering problems

2-Understand ethical and professional responsibilities

3-Use of modern engineering tools necessary for engineering practice

4-Use skills, modern techniques and tools required in the practice of material science and engineering

5- Design and conduct experiments and to collect, analyze and interpret data on the behavior of materials in engineering applications

6-Communicate effectively at personal level and through written reports and oral presentations.

الاعتماد			
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الاسم			
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الختم			