DEPARTMENT OF METALLURGICAL & MATERIALS ENGINEERING

GRADUATE PROGRAM in METALLURGICAL & MATERIALS ENGINEERING

MASTER of SCIENCE in METALLURGICAL & MATERIALS ENGINEERING PROGRAM

1. INTRODUCTION

Metallurgical & Materials Engineering discipline covers practically unlimited number of topics, and due to this fact, BS curriculum in Metallurgical & Materials Engineering is commonly designed to introduce students to the fundamental knowledge that are applicable to all materials systems. Those students who wish to concentrate on some specific parts of the materials systems should pursue a graduate degree in Metallurgical & Materials Engineering. By providing courses covering a broad range of topics in the field, MS program in Metallurgical & Materials Engineering at Atılım University provides such opportunity for those individuals who are either fresh BS graduates or practicing engineers who have had some practical experience and would like to improve their knowledge base with further formal academic study

2. PROGRAM MISSION

- to expose the students to the theoretical, technological and practical aspects of Metallurgical & Materials Engineering.
- to improve the skills of the students in the analysis and design of materials and processes in manufacturing and/or service organizations.
- to provide a solid background to those students who wish to continue to a PhD program.

3. PROGRAM OBJECTIVES

To provide students a satisfactory graduate education so that they can better :

- reach the information, evaluate and analyze them,
- gain in-depth knowledge in the field of Metallurgical & Materials Engineering,
- know how to utilize this knowledge in real world problems, and improve their problem-solving ability,
- be able to do independent research.

4. MAIN RESEARCH AREAS

- Design and Production of Engineering Materials.
- Testing, Evaluation and Characterization of Engineering Materials.
- Computations and Simulations in Materials Engineering.
- Materials Economy, Materials Management and Quality issues.

5. ADMISSION

5.1. The applicants should have a BS degree in Materials/Metallurgical Engineering (MATE/METE), or in other related engineering disciplines (such as Mechanical Engineering, Chemical Engineering, Manufacturing Engineering, Mechatronics Engineering, Ceramics Engineering, Mining Engineering) and BS from science departments (such as Physics and Chemistry).

5.2. Other admission requirements [such as language proficiency (ÜDS, KPDS, TOEFL) and graduate aptitude exam (ALES) scores] are as determined and announced by the Graduate School (FBE) of Atılım University.

5.3. Teaching language at Atılım University is English, thus each applicant has to be fluent in written and spoken English.

6. MATE-MS PROGRAM REQUIREMENTS

6.1. Structure:

MS program consists of two options: **thesis** and **non-thesis**

6.1.1. The program option with thesis requires successful completion of a minimum of **21** credit hours of course work (seven courses plus non-credit *MATE 589 Graduate Seminar*. non-credit *MATE 598 Special Studies on Thesis Subject* and a non-credit *MATE 599 Master's Thesis)*.

6.1.2. The non-thesis MS program requires successful completion of a minimum of **30** credit hours of course work (ten courses plus non-credit *MATE 500 Graduation Project)*.

Minimum course requirements for the two options are summarized in the following sections:

6.2. Details of Course Requirements for Thesis Option

THESIS OPTION			
Core Must Courses			
Course Code	**Course Name**	***Credit Hours***	**ECTS**
MATE 502	Advanced Thermodynamics of Materials	3	7.5
MATE 510	Mathematical Methods in Materials Engineering	3	7.5
MATE 585	Materials & Processes Selection & Design Problems	3	7.5
MATE 589	Graduate Seminar	NC	7.5
MATE 598	Special Studies on Thesis Subject	NC	10.0
MATE 599	Master's Thesis	NC	50.0
Core Elective Courses			
MATE xxx		3	7.5
MATE xxx		3	7.5
-			
Elective Courses			
TECE xxx		3	7.5
FREE xxx		3	7.5
Total Credit Hours		**21**	**120**

6.2.1. In thesis option, each MS student should register three MS program core must courses (a total of 9 credit hours) during the study, other than and in addition to the following three non-credit courses: *MATE 589 Graduate Seminar,* and *MATE 598 Special Studies on Thesis Subject* and *MATE 599 Master's Thesis*, depending on the option.

6.2.2. In the thesis option, each MS student should register minimum two of the MATE-MS program core elective courses (6 credit hours).

6.2.3. *MATE 589 Graduate Seminar* shall not be taken in the first semester of the MS program period.

6.2.4. In the thesis option, each MS student should take at least one free and one technical elective course (total 6 credit hours).

6.2.5. Free (FREE xxx) and Technical Elective (TECE xxx) courses are to be selected depending on the student's interest and goal. These courses should at least be fourth year undergraduate courses.

6.2.6. Non-MATE engineering graduate courses may be taken for TECExxx courses.

6.2.7. MATE & Non-MATE 4xx undergraduate courses may be taken by the approval of the department's graduate program committee. However, only up to two of such courses for the thesis option can be counted towards the degree requirements. In such case, for each of these undergraduate courses a "special studies" course should concurrently be taken, which are denoted by "MATE 580 Special Studies I" and "MATE 580 Special Studies II".

6.2.8. A maximum of three formal course work completed outside Atılım University may be counted towards the degree requirements and is subject to the approval of the department's graduate program committee. These courses may be counted as equivalents of program core must and/or core elective and/or free/technical elective courses if approved by the department's graduate program committee.

6.2.9. Graduate course names and descriptions for both core mandatory and core elective courses are provided in the following pages of this document. It should be noted that core elective courses are not limited to those listed; other courses that are of more interest to the MS students may also be offered.

6.3. Details of Course Requirements for Non-Thesis Option

NON-THESIS OPTION			
Core Must Courses			
Course Code	**Course Name**	***Credit Hours***	**ECTS**
MATE 502	Advanced Thermodynamics of Materials	3	7.5
MATE 510	Mathematical Methods in Materials Engineering	3	7.5
MATE 585	Materials & Processes Selection & Design Problems	3	7.5
MATE 500	Graduation Project	NC	15.0
Core Elective Courses			
MATE xxx		3	7.5
MATE xxx		3	7.5
MATE xxx		3	7.5
Elective Courses			
TECE xxx		3	7.5
TECE xxx			7.5
FREE xxx			7.5
FREE xxx			7.5
Total Credit Hours		**30**	**90**

6.3.1. In non-thesis option, each MS student s hould register three MS program core must courses (a total of 9 credit ho urs) during the study in addition to the *MATE 500 Graduation Project*

6.3.2. In the non-thesis option, each MS student should register minimum three of the MATE-MS program core elective courses (9 credit hours).

6.3.3. In the non-thesis option, each MS student should take at least two free and two technical elective courses (total 12 credit hours).

6.3.4. Free (FREE xxx) and Technical Elective (TECE xxx) courses are to be selected depending on the student's interest and goal. These courses should at least be fourth year undergraduate courses.

6.3.5. Non-MATE engineering graduate courses may be taken for TECExxx courses.

6.3.6. MATE & Non-MATE 4xx undergraduate courses may be taken by the approval of the department's graduate program committee. However, only up to two of such courses for the thesis option and up to three of such courses for the non-thesis option can be counted towards the degree requirements.

6.3.7. A maximum of three form al course work completed outside Atılım University may be counted towards the degree requi rements and is subject to the approval of the departm ent's graduate progra m committee. These courses m ay be counted as equivalents of program core must and/or core elective and /or free/technical elective courses if a pproved by the departm ent's graduate program committee.

6.3.8. Graduate course nam es and descriptions for b oth core mandatory and core elective courses are provided in the following pages of this document. It should be noted that core elective courses are not lim ited to those listed; other courses that are of more interest to the MS students may also be offered.

7. DEFICIENCY PROGRAM for NON-MATE/METE GRADUATES

7.1. Students with non-MA TE/METE background are required to com plete a ***student-specific deficiency program*** according to their academic/professional background.

7.2. Total course work in d eficiency program cannot exceed m ax.18 credit hours and should be completed in one calendar year.

8. PROGRAM DURATION

8.1. The thesis MATE-MS program may normally be completed in four semesters.

8.2. The non-thesis MATE-MS program may norm ally be completed within three (or 2 semesters plus summer school) semesters.

8.3. The period spent in co mpleting the deficiency program is not included in the MS program completion duration.

9. MATERIALS ENGINEERING MS PROGRAM COURSE DESCRIPTIONS

(credit hours) [ECTS]

A. Core Mandatory Courses

MATE 500 Graduate Project (NC) [15]
This course covers a broad rang e of techniques and tools rele vant to the design, analysis, development, implementation, operation and c ontrol of m odern manufacturing and quality systems in Materials E ngineering. A significant portion of this coursework is expected to involve a team project with industry. *(for non-thesis option only)*

MATE 502 Advanced Thermodynamics Of Materials (3 0 3) [7.5]
Classical and statistical therm ochemistry, with emphasis on topics important in Material s Science and Engineering; including therm odynamics of solids, solution therm ochemistry, heterogeneous equilibria of stable and m etastable phases, multicomponent systems, coherent equilibria and strain effects, interfaces and absorption, polymer alloys and solutions.

MATE 510 Mathematical Methods in Materials Engineering (3 0 3) [7.5]
Review of ordinary dif ferential equations, pa rtial differential equations, special functions, separation of variables, transform techniques, approximate techniques. Fourier and Bessel functions, boundary value problems, Laplace tr ansformation, Numerical methods to solv e differential equations, method of least squares.

MATE 585 Materials and Processes Selection and Design Problems (3 0 3) [7.5]
Design Process Steps; Design Principles; Computer Aided Engineering; Concurrent Engineering; Creativity and Prob lem Solving; Decision Theory; Computer Modeling & Simulation; Optimization; Information & Knowledge Sources for Design;Methods of Materials Selection, Processes & Process Selection; In teraction of Materials, Processing and Design; Design for Manufacture; Risk and Relia bility; Economics of Manufacturing. Quality Issues in Product & Process Desi gn. Students are requir ed to prepare and present term project on selected problems.

MATE 589 Graduate Seminar (NC) [7.5]
Presentation and discussion of current issues and works by graduate stud ents in various areas of materials engineering to stimulate research interests in graduate students.

MATE 598 Special Studies on Thesis Subject (NC) [10]
Students are assigned to work closely with their supervisors to gain knowledge on specifics of their thesis topics. Each student should comp lete a research report and suggest further research ideas in the area of interest.

MATE 599 Master's Thesis (NC) [50]
Directed independent research based study on a topic approved by the student's supervisor and the department chairman. *(for thesis option only)*

B. Core Elective Courses (partial list)

MATE 503 Computational Materials Science (3 0 3) [7.5]
Lennard-Jones model of interatom ic forces, density functional theory, Monte Carlo and molecular dynamics simulations o f free energy, phase tr ansitions, diffusion and struc ture prediction.

MATE 504 Materials Physics & Chemistry (3 0 3) [7.5]
Physical properties of a wide range of materials from the electronic and atomic point of view. The bonding and structure of m aterials will be placed in context of quantum mechanics and band theory; and the e lectrical, optical, thermal, mechanical, and magnetic properties will be emphasized.

MATE 505 Structure of Materials (3 0 3) [7.5]
Atomic arrangements in crystalline and non-crystalline materials. Crystallography, kinematic, and dynamical theories of diffraction, applic ations to x-rays, electrons and neutrons. Interpretation of diffraction pa tterns and intensity distributions, application to scattering in perfect and imperfect crystals, and amorphous ma terials. Continuum description of structure emphasizing the tensor analysis of distortions in solids.

MATE 508 Kinetics, Phase Transformations & Transport (3 0 3) [7.5]
Fundamentals of phase change, diffusion, heat tr ansport, nucleation, and growth applied to solidification; ordering, spinodal deco mposition, coarsening, reactions, massive transformations, diffusion-limited transformations and glass transitions.

MATE 509 Theory, Modeling & Simulation of Materials Behavior (3 0 3) [7.5]
Application of the mathem atical and physi cal modeling for m aterials behavior and processesing problems like plastic defor mation, creep, fatigue, sintering, electrochem ical reactions, welding, solidification, etc. Computational methods of mesoscopic, continuum, and multiscale modeling of m echanical and ther modynamic properties, phase transformations, microstructure evolution duri ng processing). Multiscale m odeling of nano/m icro composites and alloys.

MATE 512 Nanomaterials (3 0 3) [7.5]
Introduction, Nanomaterials; Nanotubes, Nanowalls, Nanowires, Nanorods, Nanoplates, Nanocomposites, Surfaces in Nanomaterials, Phase Transformations and Thermodynamics of Nanoparticles, Structures of Nanoparticles, S ynthesis of Nanoparticle s, Magnetic Properties of Nanoparticles, Optical Propert ies of Nanoparticles, Electrical Properties of Nanoparticles, Mechanical Properties of Nanoparticles, Characterization of Nanomaterials.

MATE 514 Functional Materials (3 0 3) [7.5]
Introduction to functional m aterials. Crystallography and pha se transitions in solids. Structure-property relations in materials. Semiconductors. Magnetic and m agnetostrictive materials. Phase change materials (shape memory materials). Ferroelectric films. Optical transition materials. An overview of technological applications based on electronic, magnetic, thermal, optic, dielectric, ionic conductivity or combinations of these properties.

MATE 515 Materials for MEMS Applications (3 0 3) [7.5]
Fabrication of Micro-Electro Mechanical Systems (MEMS) by bulk and surface micro machining of single crystal, polycrystal and amorphous silicon and other materials. Design, fabrication, and materials issues involved in MEMS. Material properties, structural mechanics, and packaging of MEMS. Performance issues including electrostatic, magnetic, piezoelectric actuations, residual stresses, deformation. Smart materials and materials for Nano-Electro-Mechanical (NEMS) systems.

MATE 516 Materials for Energy Technologies (3 0 3) [7.5]
Materials aspects of energy collection, conversion, storage, and delivery. Photovoltaic, nuclear, solar, and thermoelectric materials. Fuel cells and battery technologies. Low density structural materials for weight savings. Hydrogen storage materials.

MATE 518 Tool & Die Materials (3 0 3) [7.5]
Types of tools and dies. Presses, blanking and piercing dies. Tool and die steels. Classification, production and properties of tool and die materials. Materials for high temperature and high pressure dies. Moulds for plastics. Die casting dies.

MATE 520 Materials Processing During Casting (3 0 3) [7.5]
Solidification Processes; Casting Hydrodynamics; Inclusion Control in Gating Systems; Heat Transport in Component Casting, Continuous Casting, ESR process, Near Net Shape Casting and Spray Casting; Structure Formation in Cast Materials; Cooling Curves; Dendrite Structure and Dendrite Growth; Microsegregation and Macrosegregation in Alloys; Solidification and Cooling Shrinkage of Metals and Alloys; Heat Treatment, Change of Casting Structure During Cooling and Plastic Deformation; Precipitation of Pores and Slag Inclusions during Casting Processes.

MATE 528 Welding Metallurgy & Technology (3 0 3) [7.5]
Basic welding processes (gas, arc, laser-beam and electron-beam welding). Metallurgy of welding. Weld metal solidification (grain structure, subgrain structure, microsegregation, macrosegregation, porosity, inclusions and cracking). Heat-affected zone (loss of strength, embrittlement and cracking in work-hardened materials, precipitation-hardening materials, transformation-hardening materials and corrosion-resistant materials). Residual stresses and distortions. Testing and inspection of welds. Welding of alloy and carbon steels, cast iron and non-ferrous materials.

MATE 530 Physical Metallurgy of Steels (3 0 3) [7.5]
Interstitial and Substitutional Solutes in Alpha Iron and Their Interactions ; Effects of Substitutional Solutes on Precipitation of Iron Carbides; Factors Affecting the Yield and Tensile Strengths of Carbon Steels; Dual-Phase Carbon Steels; Inclusion Shape Control; HSLA Steels; Heat-Treated Steels ; The Boron Effect; Thermomechanical Treatment of Steels; Very High Strength Steels; Steels for Magnetic and Electrical Applications; Stainless Steels; Tool Steels.

MATE 535 Integrated Iron and Steel Plants (3 0 3) [7.5]
Fundamentals of iron and steelmaking. Review of basic principles of blast furnace, pretreatment of hot metal, oxygen steelmaking processes, ladle refining & vacuum degassing, tundish operations and continuous casting processes. Steel plant refractories. Alloying elements in continuously cast steel products. Stainless steel production.

MATE 536 Developments in Steelmaking Technologies (3 0 3) [7.5]
Review of BOF steelmaking and s econdary metallurgical processes. Recent developments in steelmaking technologies: Operations conducted at the converter, at the ladle furnace, at the vacuum degasser, at the tundish and at the co ntinuous casting mould, etc. in relation to steel cleanliness as well as process improvement and production costs.

MATE 537 Production of Ferroalloys (3 0 3) [7.5]
Production of ferroalloys by carbotherm ic reduction, with special empha sis on ferrosilicon; Production of ferroalloys by m etallothermic and vacuum reduction te chniques; Detailed explanation of ferrochrom ium, ferromanganese, ferrotitanium, ferrovanadium, ferrotungsten, ferromolybdenum and ferronickel production.

MATE 540 Advanced Ceramic Engineering (3 0 3) [7.5]
Structure of ceram ic materials. Characterization of particulate system s. Packing of powders. Analysis of ceram ic forming methods. Mechanisms and kinetics of sintering. Property development through process and structure control.

MATE 541 Advanced Glass Science and Technology (3 0 3) [7.5]
Composition and struc ture of glass. Com position-structure-property relations in glasses. Physical properties, Chemical properties, Thermal properties, Mechanical properties, Optical properties, Electrical properties; factors affecting these properties. Engineering the factors for specific glass applications. Testing of glassware. Processing and properties of glass-ceramics.

MATE 544 Powder Metallurgy (3 0 3) [7.5]
Principles of the P/M process. Metal powde r production methods. Pow der characterization, properties of m etal powders and their tes ting. Compaction processes. Densification mechanisms. Sintering theory. Liquid phase an d activated sintering. Sintering atmospheres and furnaces. Full density processing. Finish ing operations. Com pact characterization. Plasticity of porous materials. Mechanical properties of P/M materials.

MATE 545 Advanced Polymers (3 0 3) [7.5]
Polymer Synthesis; Polymerization types, Polym erization techniques, Reactions of Syntheti c polymers, Special topics in polymer synthe sis, Conformation, Solutions and Molecular Weight; Polymer conformation and chain dimensions; Thermodynamics of polymer solutions, Measurement of molecular weight, Solid State Properties; Amorphous state, Crystalline state, Thermal transitions and properties, Mechanical properties, Additives, Blends and Composites; Additives, Polymer blends and interpenetrating networks, Polymer composites,

MATE 546 Polymers for Advanced Technologies (3 0 3) [7.5]
Biopolymers, Naturel Polym ers and Fibers, Th ermoplastics, elastomers and Therm osets, Engineering and Speciality Polymers, Mem brane Science and Technology, Biom edical Engineering and Drug Delivery, Applications in electronics, Photonic polymers.

MATE 547 Polymer Processing and Rheology (3 0 3) [7.5]
Basic processing operations, Intr oduction to polym er rheology, An alysis of sim ple flows, Rheometry, Modelling of polymer processing operations.

MATE 548 Advanced Biomaterials (3 0 3) [7.5]
Classification of Biomaterials; Polymeric, Metallic, Ceramic and Composite, Choice of Biomaterials for Biomedical Applications, Biomaterial Surfaces and Physiological Environment, Engineering Biomaterial Surfaces, Biocompatibility.

MATE 549 Tissue Engineering (3 0 3) [7.5]
Definitions of Tissue-Cell; Structural Properties, Metabolic Activities, Cell and Tissue Culture; Fundamental Principles, Tissue Engineering-Biomaterial Interactions, Protein-Biomaterial-Surface Interactions, Cell-Biomaterial Interactions, Organ Failure and Regeneration; The Effect of Shear Force on Cellular Functions; The Role of Mass Transfer for Tissue functions; Tissue Microenvironment; Production of Various Tissues with Tissue Engineering Principles.

MATE 555 Quality Management Systems in Materials Industry (3 0 3) [7.5]
Application of the concepts and tools of total quality to develop, implement, and maintain an effective quality assurance system in a materials manufacturing or service organization. Documentation development and team-based strategies for continuous improvement, using the ISO 9001 Standard as a basis for quality system requirements. Basic elements of a quality assurance system; quality standards such as ISO 9001, QS 9000, ISO 16949, ISO 14001, others; structuring QMS documentation, strategic and competitive issues in QMS, continuous improvement through corrective and preventive actions. Concept of Total Quality Management and Quality Assurance. On-Line and off-Line Quality Control Activities. Quality Engineering in Product and Process Design. Taguchi's Loss Function.

MATE 556 Materials Engineering Management (3 0 3) [7.5]
This course addresses the role of the materials engineer as a "manager" of continuous improvement in materials design and production processes. Modern tools and techniques for planning and managing team projects involving facilities planning and design, materials and process selection and design, integrating the concepts of total quality; data based decision-making, and resource management issues. Current Cost management topics such as activity based costing, life cycle costing, target costing and throughput accounting are focused. Emphasis will also be placed on the linkages to advanced manufacturing systems including performance measurement, design, cellular manufacturing, JIT and ERP.

MATE 560 Tribology (3 0 3) [7.5]
Characterization of surfaces, interaction of surfaces, theories of contact mechanics, fundamentals of friction, fundamentals of lubrication, types of wear, measurement of wear, tribology of engineering materials, tribology of machinery and vehicle components, tool wear and lubricants in metal cutting and shaping, tribology of hip and knee joint replacements.

MATE 565 Coatings and Thin Films (3 0 3) [7.5]
Surface coating methods: Gaseous, solution and molten state deposition processes, fundamentals of vacuum technology, principles of physical and chemical vapor deposition, electrochemical deposition, origins of film stress, characterization of coatings, tribology of coatings, tool and die coatings, diamond and diamond-like carbon coatings.

MATE 570 Advanced Mechanical Behavior (3 0 3) [7.5]
Advanced studies of deformation and failure in materials. Macroscopic and microscopic aspects of deformation. Elasticity and plasticity theories and problems in deformation processing. Fracture mechanics and composite toughening mechanisms. Mechanisms of creep deformation. Fatigue.

MATE 572 High Temperature Materials (3 0 3) [7.5]
Principles of materials behavior at high tem peratures. Microstructure-property relationships including phase stability and co rrosion resistance to high temperature materials. Fracture and fatigue at elevated temperatures. Damage accumulation behavior and engineering applications of service life techniques.

MATE 574 Mechanics & Metallurgy of Metal Forming (3 0 3) [7.5]
Stress and Strain Tensors; Yi eld Criteria; Flow Rules; Plastic Ins tability; Deformation Mechanism Maps; Uniform Energy; Extrusi on; Bar Drawing; Redundant W ork; Slab Analysis of Rolling and Sheet d rawing; Slip Line Fie ld Theory; Formability; Plastic Anisotropy; Forming Limit Diagrams; Sheet Me tal Properties of Metal Alloys of Common Use.

MATE 576 Nuclear Reactor Materials (3 0 3) [7.5]
Review of crystal structures, point defects and dislocations. Diffusion of point defects in solids. Thermal diffusion in uranium dioxide. Stress and Strain Energies near D islocation Cores from Elastic Continuum Predictions. Radiation Damage in Solids, Kinematics of Elastic Collisions, Energy Dependent Hard Sphere Ion-Ion Scattering Approxim ation, Displacement Cascade, Spatial Dis tribution of Displacement from Neutrons, Damage from Ion Bombardment, Displacements in UO_2 from Fission Fragments. Selected radiation effects in materials: Embrittlement, Void Swelling in Alloys, Bubble Growth and Resolution in UO_2, Radiation Enhanced Fatigue and Creep.

MATE 578 Failure Analysis of Materials (3 0 3) [7.5]
Analysis of failed structures due to tensile overload, creep, fatigue, stress corrosion, wear and abrasion, with extensive use of scanning electron m icroscope. Identification and role of processing defects in failure.

MATE 580 Special Studies I (0 0 0) [2.5]
Students who are registered to an undergraduate elective course should take th is course and are expected to carry out additional work (such as project, literature review a presentation etc) assigned by the course instructor.

MATE 581 Special Studies II (0 0 0) [2.5]
Students who are registered to an undergraduate elective course should take th is course and are expected to carry out additional work (such as project, literature review a presentation etc) assigned by the course instructor.

MATE 586 Independent Study I (3 0 3) [7.5]
Students are assigned to work closely with one or m ore faculty m embers to gain expert knowledge on a specific topic in materials engineering. Each student (either individually or as a member of a team) should either com plete a design project and m anufacture the design product, or carry out a detailed experiment (design or us e an available setup) with an engineering evaluation report.

MATE 587 Independent Study II (3 0 3) [7.5]
Students are normally expected to continue their work that th ey have started in MA TE 586 at an advanced level. The work should normally end with a draft publication.

10. SAMPLE PROGRAM for THESIS OPTION

Semester 1 THESIS OPTION				
Course Code	**Course Name**	**Category**	***Credit Hours***	**ECTS**
MATE 502	Advanced Thermodynamics of Materials	required	3	7.5
MATE 510	Mathematical Methods in Materials Engineering	required	3	7.5
MATE xxx		elective	3	7.5
TECE xxx		elective	3	7.5
Total Credit Hours			**12**	**30**

Semester 2 THESIS OPTION				
Course Code	**Course Name**	**Category**	***Credit Hours***	**ECTS**
MATE 585	Materials & Processes Selection & Design Problems	required	3	7.5
MATE 589	Graduate Seminar	required	NC	7.5
MATE xxx		elective	3	7.5
MATE 599-1	Master's Thesis	required	NC	7.5
Total Credit Hours			**6**	**30**

Semester 3 THESIS OPTION				
Course Code	**Course Name**	**Category**	***Credit Hours***	**ECTS**
MATE 598	Special Studies on Thesis Subject	required	NC	10.0
FREE xxx		elective	3	7.5
MATE 599-2	Master's Thesis	required	NC	12.5
Total Credit Hours			**3**	**30**

Semester 4 THESIS OPTION				
Course Code	**Course Name**	**Category**	***Credit Hours***	**ECTS**
MATE 599-3	Master's Thesis	required	NC	30.0
Total Credit Hours			**0**	**30**

11. SAMPLE PROGRAM for NON-THESIS OPTION

Semester 1 NON-THESIS OPTION				
Course Code	**Course Name**	**Category**	***Credit Hours***	**ECTS**
MATE 502	Advanced Thermodynamics of Materials	required	3	7.5
MATE 510	Mathematical Methods in Materials Engineering	required	3	7.5
MATE xxx		elective	3	7.5
TECE xxx		elective	3	7.5
Total Credit Hours			**12**	**30**

Semester 2 NON-THESIS OPTION				
Course Code	**Course Name**	**Category**	***Credit Hours***	**ECTS**
MATE 585	Materials & Processes Selection & Design Problems	required	3	7.5
MATE xxx		elective	3	7.5
MATE xxx		elective	3	7.5
FREE xxx		elective	3	7.5
Total Credit Hours			**12**	**30**

Semester 3 NON-THESIS OPTION				
Course Code	**Course Name**	**Category**	***Credit Hours***	**ECTS**
TECE xxx		elective	3	7.5
MATE 500	Graduation Project	required	0	15
FREE xxx		elective	3	7.5
Total Credit Hours			**6**	**30**

12. DIPLOMA SUPPLEMENT

(attached to this document for both Thesis & Non-Thesis options)