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Information and guidelines for the graduate students of the Mechanical Engineering Department for the academic year 2014-2015

Mechanical Engineering Department
Eastern Mediterranean University
Gazimağusa,T.R.N.C.

Tel: +90 392 6301210
Fax: +90 392 3653715
e-mail: medept@me.emu.edu.tr
URL: http://me.emu.edu.tr

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GENERAL INFORMATION

The Department of Mechanical Engineering (ME) is one of the first three departments established in this University. The Department offers programs of study leading to the degrees of Bachelor of Science (B.S.), Master of Science (M.S.), and Doctor of Philosophy (Ph.D.).

The Department is committed to foster mechanical engineers who are prepared to contribute to society with reliable basic technological skills and proficiency in their field. For this purpose, some educational targets are set as the students are requested to study intensively towards these targets. Faculty members are constantly improving the educational curricula in order to prepare they graduate highly qualified students who have fulfilled all requirements by the time.

Our aim is to enable students to acquire the technological skills to see things from multiple standpoints in a global perspective by learning extensively from the humanities, social sciences, languages, etc., and by mastering an intense academic background without a favor toward technological knowledge.

Graduate research in the Department is conducted primarily in the areas of thermal and fluid sciences, mechanics, machine design, mechatronics, automation, materials and manufacturing.

ADMISSION REQUIREMENTS TO GRADUATE PROGRAMS IN MECHANICAL ENGINEERING

M.Sc. in Mechanical Engineering

M.Sc. program requires a minimum CGPA of 2.75/4.0 (or international equivalent) in a related science or engineering discipline; for applicants with CGPA below 2.75 (between 2.5 and 2.75) the departmental graduate committee may ask the candidates to take a number of deficiency courses from the undergraduate program before they are admitted to the program.

Ph.D. in Mechanical Engineering

For the Ph.D. program the standard academic entry requirement is a minimum CGPA of 3.0/4.0 (or international equivalent) obtained from a related science or engineering undergraduate discipline. The applicant is also required to have a master's degree in a mechanical engineering-related field and submit a research proposal (brief explanation about his/her research interests). Admission of applicants to the Ph.D program is subject to the availability of a supervisor in the proposed research field.

CURRENT RESEARCH INTERESTS OF DEPARTMENT

1. ***Energy***
   - Solar energy applications in buildings
   - Solar air heating
   - Solar water heating
   - Solar desalination
   - Solar energy integrated vehicles
   - Energy generation systems (nuclear and fossil fuel power plants)
2. ***Energy management***
   - Demand-side management
   - Integrated resource planning
   - Efficient energy utilization
   - Energy demand prediction
3. ***Thermodynamics***
   - Advanced power cycles

- Absorption cycles
- Thermo-elasticity
- Computational heat dynamics

4. Fluids

- Computaional fluid dynamics
- Flow simulation on unstructured grids
- Parallel programming in CFD
- Solution methods of fluid flow equations
- Two phase flows (interface tracking methods, and melting and solidification)
- Simulation of turbulent flows (RANS and LES methods)
- Nanofluids and applications

5. Aerodynamics

- Flow properties behind bluff bodies
- Flow interactions between different cross sections
- Analysis of aero-engine turbine blades

6. Automotive

- Vehicle dynamics
- Improving combustion process in I.C. engines
- Metallic and ceramic engines
- Simulation studies of different compound engine schemes
- Computer modeling of general thermodynamic systems

7. Biomechanics

- Design and development of diarthrodial joint prosthesis
- 6DOF kinematic analysis of joint prosthesis
- Simulation of wear at contact point of prosthesis
- Modelling of human body joints as 6DOF unconstrained joints
- FE analysis of diarthrodial joints
- Predicting injury mechanisms of joints and tissues
- Dynamics of vehicles

8. Multidisciplinary design optimization of mechanical structures

- Geometry modification of complex structures
- Design under uncertainties
- Dealing with nonlinear mechanical problems using high performance computing methods

9. Vibration, acoustics and vibro-acoustics

- Designing of quiet structures
- Self-excited vibrations
- Energy harvesting by piezoelectric
- Optimum vibro-acoustics design of mechanical structures, e.g, mufflers, wind turbines, human hearing implants.

10. Dynamical systems and control

- Structures under impacts, e.g., airplane landing gears system
- Robotics
- Control of hybrid electric power-trains

11. Manufactuing systems

- Distributed control/manufacturing systems (IEC 61499)
- Wireless sensor networks and RFID applications in manufacturing
- Modeling framework for organizational competency
- Collaborative networks
- Intelligent manufacturing systems - holonic manufacturing systems
- Development of computer aided engineering software (CASE tools)
- Process planning and scheduling integration for SMEs

12. Manufactuing processes

- Incremental sheet forming

- Metal spinning
- Friction stir processing
- Friction stir welding
- Hybrid welding
- High speed milling
- Water jet machining
- Laser cladding
- Analytical modelling of manufacturing processes

13. Matreial science and engineering

- Mechanical behavior of materials (fatigue, creep, fracture)
- Film formation and its chacterization
- Plastic deformation and microstrutcal effects
- Prediction of fracture and forming limits
- Heat treatment
- Surface alloying
- Thermo-magnetic materials and applications

GRADUATE PROGRAM IN MECHANICAL ENGINEERING

The graduate programs (MSc. and Ph.D) in Mechanical Engineering is in full compliance with the rules and regulations outlined in the "Doğu Akdeniz Üniversitesi Lisansüstü Öğretim Yönetmeliği". In addition, the following requirements set by the Mechanical Engineering Department should be fulfilled.

1- The fields of study in the Mechanical Engineering Department are classified into three groups *Thermal-fluid Science and Energy; Materials and Manufacturing; Mechanics and Machine Design*

2- Students accepted for the graduate program should have taken the courses or their equivalents as given below. Otherwise the candidate will be asked to take all or some of the courses not taken before.

   (a) Thermal-fluid Science Energy: Thermodaynamics (MENG 245, 246), Heat Transfer (MENG 345), Fluid Mechanics (MENG 353)
   (b) Materials and Manufacturing: Materials Science (MENG 286), Manufacturing Processes (MENG 364), Strength of Materials (MENG 222)
   (c) Mechanics and Machine Design: Dynamics of Machinary (MENG 331)), Control System (MENG 332), Machine Elements (MENG 375, 376)
   (d) Engineering Mathematics courses are prerequisite for students in all of three groups besides familiarity in one computer language, (such as Fortran, C, C++ Pascal, Basic,…..)

MASTER OF SCIENCE

1- A Master student needs to take 7 Technical courses and 2 Non-credit courses (Seminar and Advanced writing) as one of Master degree requirement.
2- Two MATH courses, as approved by the department, are compulsory for every student.
3- Besides MATH and Non-credit courses, a student needs to take at least 3 departmental courses (i.e., with MENG code).
4- The remaining 2 courses are elective and can be taken with the permission of concerned supervisor.
5- A Master student can take an undergraduate course (from area electives with MENG 400 code), which will be counted as one of the three departmental courses required to be taken.

DOCTORATE OF PHILOSOPHY

1- A PhD student needs to take 7 Technical courses and 2 Non-credit courses (Seminar and Advanced writing) as one of Master degree requirement. However, Advanced writing can be exempted for a student if he/she has already taken this course in Master program.
2- Two MATH courses, as approved by the department, are compulsory for every student.
3- Besides MATH and Non-credit courses, a student needs to take at least 3 departmental courses (i.e., with MENG code).
3- The remaining 3 courses are elective and can be taken with the permission of concerned supervisor.
4- A PhD student, contrary to a Master student, is not allowed to take any undergraduate course (with 400 code).
5- After fullfilling the course requirement, the student is required to register for PhD qualifying exam with the advisor. Prior to appear in exam, applicant (or supervisor) must update graduate school by by filling the relavant form. This exam consists of two parts; written and oral exams. The objective of the written exam is to test the student's background in the proposed field of research.

i-The streams and the relavant subjects of the written exam are as follows:

a- Thermal Energy and Fluid Science group

1- Applied Mathematics
2- Heat Transfer
3- Thermodynamics
4- Fluid Mechanics

b- Materials and Manufacturing group

1- Applied Mathematics
2- Materials Science
3- Manufacturing Pocesses
4- Strength of Materials

c- Mechanics and Machine Design group

1- Applied Mathematics
2- Machine Elements
3- Dynamics and Vibration
4- System Control

ii- The exam depending on the instructor could be open or close book.
iii-The exam (written & oral) is organized and evaluated by a committee with ***at least three members.***
iv-To qualify exam, a student should secure at least 65% marks in each subject.
v-Students who fail the qualifying examination are allowed to retake the exam for the second time only after three months.
vii- In case a student successfully qualifies exam, he must appear for oral exam, preferrably within a week. He is expected to explain his research plan thoroughly.
vi-Further requirements for thesis and graduation are outlined in "Lisansüstü Öğretim Yönetmeliği".

COURSE DESCRIPTIONS OF GRADUATE PROGRAM

MENG 511 Applied Computational Methods for Engineers (3,0) 3
The course is an applied approach to solve different types of equations that aries in engineering analysis. The course contains: solution of systems of linear algebraic equations, eigen-value problems; nonlinear equations; polynomial approximation, numerical differentiation and integration; ordinary differential equations and partial differential equations.

MENG 522 Fracture Mechanics (3,0) 3
Mechanism of fracture and crack growth. The elastic crack-tip stress field, the crack-tip plastic zone. The energy principle; energy release rate, criterion for crack growth, crack resistance, compliance, J-Integral and tearing modulus. Dynamic fracture mechanics and crack arrest. Plane strain fracture toughness, plane stress and transitional behaviour. Elastic-plastic fracture, fatigue crack propagation, fracture resistance of materials. Application of fracture mechanics. Prediction of fatigue crack growth.

MENG 525 Elasticity (3,0) 3
Analysis of stress and strain. Constitutive equations. Plane problems of elasticity. Torsion and flexure of beams. Variational methods, theorems of minimum potential energy and complementary energy. Approximate solution by means of variational methods. Introduction to plate theory.

MENG 533 Advanced Mechanical Vibrations (3,0) 3
1D Wave examples (strings), Sound in fluids, Acoustic impedance, Source energy, intensity and power, Sources, reciprocity, Green's functions, etc., Sound absorption and absorbing materials, Sound in waveguides, mufflers and silencer, Sound in enclosures

MENG 541 Advanced Thermodynamics (3,0) 3
The first and second laws of thermodynamics. The two laws combined: the destruction of energy. Energy generalized. Single-phase, multiphase and chemical reactive systems. Refrigeration and power generation. Thermodynamic design.

MENG 542 Components of Energy Systems (3,0) 3
Piping systems, Heat exchangers, Prime movers, pumps, fans, nozzles, turbines, modeling and simulation, Steady-state simulation, Transient simulation, System optimization and risk analysis, Uncertainty analysis, Fluid transients.

MENG 544 Advanced Heat Transfer (3,0) 3
Conservation principles; mass, momentum and energy. Fluid stresses and flux laws; boundary layer theory and the integral equations of the boundary layer. Momentum and heat transfer in laminae in external and internal flow. Momentum and heat transfer in turbulent external and internal flow; natural convection.

MENG 545 Transport Phenomena (3,0) 3
Heat, mass and momentum transfer with emphasis on the analogies between them. Introduction to transport phenomena. Heat, mass and momentum diffusivities. The balance or conservation concept. One and more dimensional balance equation. Steady-state transport. Transport with a net convection flux. Fluid flows in duct. Heat and mass transfer in duct flow. Unsteady-state transport. Transport coefficient.

MENG 546 Advanced Internal Combustion Engines (3,0) 3
Review of basic principles of engine operation. Thermo-chemistry and properties of engine working fluids. Thermodynamic analysis of engine processes. Mathematical modeling and simulation of engine processes and cycles. Study of various engine schemes.

MENG 547 Energy Management and Utilization (3,0) 3
Energy consumption, conservation and resources. Energy audits, economic analysis. Management and organization of conservation programs. Analysis of thermal-fluid systems. Energy conservation in combustion systems, steam and condensate systems. Heat exchangers, heat recovery and insulation. Energy conservation in industrial system, industrial cogeneration. Power circuits, electrical machinery, electrical energy conservation. Industrial energy use profiles.

MENG 548 Power Generation Systems (3,0) 3
Thermal power plants, steam power plants, solar thermal power plants, Organic Rankine Cycle, Gas Turbines, Carbon dioxide power cycles, Diesel power plants, Other power generating systems, Economic analysis of power plants, power plant simulation and performance analysis.

MENG 551 Advanced Fluid Mechanics (3,0) 3
Fundamentals equations, flow kinematics and special forms of governing equations. Two-dimensional potential flow, three-dimensional potential flow. Viscous flow: incompressible flow and compressible flow of fluids.

MENG 555 Computational Fluid Dynamics (CFD) (3,0) 3
Introduction, vector and tensor algebra; Governing equations; Equilibrium equations; Diffusion equation; Euler equation; Advection equations; advection-diffusion equation; boundary and initial conditions; Permeative and stream function-vorticity approach; Approximate methods. Finite difference, weighted residual-finite elements, finite volume; Accuracy and error analysis, Higher order schemes; Staggered grid concept; Pressure correction schemes; Flow in porous media, turbulent flow modeling.

MENG 559 Transport Phenomena in Porous Media (3,0) 3
Emphasis on the principle of mechanics of fluid flow through a porous medium, (continuity equation, momentum equation with its extensions), heat transfer through a porous meduium (energy equation with its extensions to more complex situation), mass transfer, force convection, external natural convection, internal natural convection and mixed convection in a porious medium and their application for solving engineering problems.

MENG 561 Manufacturing Systems Engineering (3,0) 3
CAD/CAM Hardware; CAD/CAM software, Integrative manufacturing Planning and control, Group Technology, Computer Integrated manufacturing (CIM), Modeling methodologies and analysis tools for CIM, Systems analysis and design methods, Computer Assisted Systems Engineering (CASE).

MENG 562 Advanced CAD/CAM (3,0) 3
Principles of CAD, Mathematical theory of graphics, Principles of geometric modeling, Terminology of bezier curves, B splines and NURBS, Parametric representation of curves and surfaces; Principles of NC technology and its components, Adaptive control technology, Necessities and types of precise tooling in NC based manufacturing, Advanced methods for NC program of instructions, Information requirements of manufacturing, Role of group technology in CAM, Contribution of CAD/CAM and NC technology in advanced manufacturing

MENG 575 Advanced Biomechanics (3,0) 3
Introduction to mechanics and biomechanics; Static, Kinematic and Dynamic concepts for analyzing musculoskeletal joint motion; Joint mechanics; Musculoskeletal tissues and tissue modeling; Biomaterials; Joint prosthesis design and analysis; Implant materials and coating; Musculoskeletal and artificial joint contact and tribology; Software for analyzing human body joints.

MENG 582 Plastic Forming of Metals (Plasticity) (3,0) 3
Stress, Strain, Macroscopic plasticity and yield criteria, Work hardening, Plastic instability, Strain rate and temperature, Ideal work, Slab analysis, Formability, Forming limits, Advanved forming processes

MENG 583 Application of Virtual Reality (VR) in Manufacturing (3,0) 3
Design-Centered Virtual Manufacturing (VM) – part modeling, rapid prototyping, virtual assembly, and prototyping of mechanical systems. Production-Centered VM-shop floor planning, virtual manufacturing cell, virtual manufacturing process. Virtual Machining-constructing a virtual operation, process simulation and prediction, virtual numerical control. VR Instruments-hardware, software, VR programming.

MENG 584 Advanced Manufacturing Processes (3,0) 3
Advanced materials and material Technologies, Materials developed through Space Related Technologies, Advanced processes for plastic forming and casting; Precision machining-sources of error (Thermal, Static, Dynamic, Process Related), Precision machining processes, Vibration and thermal assisted machining, High-speed processing, Application of FEM in machining, Manufacturing of semiconductor devices, Electronic assembly and packaging, Rapid prototyping technologies; Manual and computer assisted part programming, Flexible manufacturing systems [FMS] and Robotics.

MENG 587 Mechanical Behavior of Materials (3, 0) 3
Elastic properties Mechanical tests Micro-plasticity of crystals and plastic deformation Grain boundaries Strain-hardening Creep Strengthening mechanisms(solute-hardening, precipitation-hardening) Fracture-brittle fracture (Griffith theory) Ductile fracture (ductile-brittle transition) Fatigue fracture.