(It will be applied from 2016-2017 Fall)

İZMİR INSTITUTE OF TECHNOLOGY
GRADUATE SCHOOL OF ENGINEERING AND SCIENCES
DEPARTMENT OF MECHANICAL ENGINEERING
CURRICULUM OF THE GRADUATE PROGRAMS

M.S. in Mechanical Engineering

Core Course

ME 500	M.S. Thesis	(0-1)NC
ME 590	Analytical Methods in Engineering	(3-0)3
ME 598	**M.Sc. Research Seminar***	**(0-2)NC**
ME 599	**Methods and Ethics in Engineering Research****	**(0-2)NC**
ME 8XX	Special Studies	(8-0)NC

In addition to above courses, at least 6 courses can be taken from the list of elective courses to complete required 120 ECTS (AKTS) credits.

* **All M.S. students must register M.Sc. Research Seminar course until the beginning of their 4th semester.**
** **"ME 599 Methods and Ethics in Engineering Research" course should preferentially be taken within the first 2 semesters.**

Total minimum credit: 21
Number of courses with credit (min): 7

Ph.D. in Mechanical Engineering

Core Courses

ME 590	Analytical Methods in Engineering***	(3-0)3
ME 599	**Methods and Ethics in Engineering Research****	**(0-2)NC**
ME 600	Ph.D. Thesis	(0-1)NC
ME 698	**Ph.D. Research Seminar**	**(0-2)NC**
ME 8XX	Special Studies	(8-0)NC

In addition to above courses, at least 6 courses can be taken from the list of elective courses to complete required 240 ECTS (AKTS) credits.

*** **If this course or equivalent one is already taken, one additional course is required.**
**** **"ME 599 Methods and Ethics in Engineering Research" course should preferentially be taken within the first 2 semesters. If this course or an equivalent one is already taken, the student is exempt from the course.**

Total credit (min.) :21 (for students with M.S. degree)
Number of courses with credit (min.): 7 (for students with M.S. degree)
Total credit (min.) : 42 (for students with B.S. degree)
Number of courses with credit (min.): 14 (for students with B.S. degree)

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Elective Courses

ME	501	Microstructure and Mechanical Properties		(3-0)3
ME	504	High Strain Rate Mechanical Behaviour of Materials		(3-0)3
ME	505	Quality Control		(3-0)3
ME	507	Analytical Techniques in Materials Science		(3-0)3
ME	508	Phase Transformations and Kinetics		(3-0)3
ME	509	Engineering Continuum Mechanics		(3-0)3
ME	510	Fracture Mechanics		(3-0)3
ME	511	Numerical Methods in Mechanical Engineering		(3-0)3
ME	512	Analytical and Numerical Methods for Phase Change Problems		(3-0)3
ME	513	Advanced Composite Techniques		(3-0)3
ME	514	Phase Diagrams in Materials Science		(3-0)3
ME	515	Finite Element Analysis in Solid Mechanics		(3-0)3
ME	516	Finite Element Analysis in Vibrations		(3-0)3
ME	517	Advanced Ceramics		(2-2)3
ME	518	Analytical Methods in Vibrations		(3-0)3
ME	519	Advanced Mechanics of Materials		(3-0)3
ME	521	Advanced Thermodynamics		(3-0)3
ME	522	High Temperature Materials		(3-0)3
ME	523	Heat Conduction		(3-0)3
ME	524	Experimental Design		(1-4)3
ME	525	Thermal Radiation		(3-0)3
ME	526	Theory of Turbulence		(3-0)3
ME	527	Turbulence-II : Experiments and Computations		(2-2)3
ME	530	Constructal Theory and Design		(3-0)3
ME	532	Convective Heat Transfer		(3-0)3
ME	534	Advanced Fluid Mechanics		(3-0)3
ME	536	Computational Fluid Dynamics		(3-0)3
ME	538	Acoustic Waves		(3-0)3
ME	540	Applied Combustion		(3-0)3
ME	542	Advanced Combustion in Engines		(3-0)3
ME	**543**	**Advanced Technologies for Pollutants Control in Engines**		**(3-0)3**
ME	545	Direct Use of Geothermal Energy		(3-0)3
ME	550	Wind Power		(3-0)3
ME	554	Geothermal Engineering		(3-0)3
ME	555	Microfluidic Theory		(3-0)3
ME	559	Plates and Panels		(3-0)3
ME	560	Sandwich Structures		(3-0)3
ME	561	Metal Cutting		(3-0)3
ME	563	Theory of Elasticity		(3-0)3
ME	565	Shell Structures		(3-0)3
ME	567	Robotics Research		(3-0)3
ME	568	Mechatronics	*Pre.-ME590*	(2-2) 3
ME	570	Computational Intelligence		(3-0)3
ME	**571**	**Kinematic Analysis of Mechanisms**		**(3-0)3**

(It will be applied from 2016-2017 Fall)

ME	**572**	**Structural Design of Mechanisms**		**(3-0)3**
ME	573	Deployable Structures		(3-0)3
ME	**574**	**Principles of Robotics I**		**(3-0)3**
ME	575	Kinematic Geometry of Robotics	***Pre.-ME571/ ME 574***	(3-0)3
ME	576	Computer Control of Machines		(3-0)3
ME	**577**	**Kinematic Synthesis of Mechanisms**		**(3-0)3**
ME	***578***	***Probabilistic Reasoning***		***(3-0)3***
ME	**579**	**Principles of Robotics II**	***Pre.-ME571/ ME 574***	**(3-0)3**
ME	580	Haptics and Teleoperation		(3-0)3
ME	581	Machine Tool Design		(3-0)3
ME	583	Industrial Fault Detection and Identification		(3-0)3
ME	585	Nanomaterials		(3-0)3
ME	587	Microcontroller Embedded Systems		(3-0)3
ME	**588**	**Advanced Dynamics**		**(3-0)3**
ME	**589**	**Modern Control**		**(3-0)3**
ME	590	Analytical Methods in Engineering		(3-0)3
ME	591	Special Topics in Mechanical Engineering		(2-2)3
ME	**598**	**M.Sc. Research Seminar**		**(0-2)NC**
ME	**599**	**Methods and Ethics in Engineering Research**		**(0-2)NC**
ME	500	M.S. Thesis		(0-1)NC
ME	600	Ph.D. Thesis		(0-1)NC
ME	**698**	**Ph.D. Research Seminar**		**(0-2)NC**
ME	8XX	Special Studies		(8-0)NC

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COURSE DESCRIPTIONS

ME 501 Microstructure and Mechanical Properties (3-0)3

Deformation types. Dislocation mechanics. Deformation by slip and twinning. Fracture in common engineering materials; brittle and ductile fractures. Grain size, solute atom and precipitate strengthening mechanisms in metals. Ceramics and their microstructure. Composites' microstructures and mechanical properties.

ME 504 High Strain Rate Mechanical Behavior of Materials (3-0) 3

Elastic and plastic stress waves Shock waves and their production. High strain rate testing methods. Plastic deformation at high strain rates. Constitutive equations for metals. Mechanics and microstructure of adiabatic shear band formation. Failure and fracture associated with dynamic loading. Civilian and military applications of high strain rate phenomena.

ME 505 Quality Control (3-0)3

Impact of quality and the meaning of quality. Product, technology and the internationalization of quality. Quality Engineering. Process Control Engineering, Fundamentals of Statics. Control Charts. Reliability. Quality cost.

ME 507 Analytical Techniques in Materials Science (3-0)3

Study of the mechanical, thermomechanical, physical and microstructural characterisation of materials. Materials system include metals, ceramics, polymers, composites and surfaces and interfaces in these systems. Applications to mechanical property characterisation. Fracture and fractography. Surfaces and interfaces. Dynamic mechanical analysis of polymeric materials. Optic and scanning electron microscopy. Polymer molecular structure determination and durability experiments.

ME 508 Phase Transformations and Kinetics (3-0)3

Thermodynamics and phase diagrams. The kinetics of phase transformations. Analysis of kinetic data. Kinetics of solidification, homogenization and precipitation process in solids. Diffusion. Interfaces. Nuclation. Solidification of pure metals and alloys. Classification of solid state phase transformations. Diffusional and diffusionless transformations in solids.

ME 509 Engineering Continuum Mechanics (3-0)3

Introduction to Continuum Mechanics, Review on Essential Mathematics, Stress Principles, Kinematics of Deformation and Motion, Fundamental Laws and Equations, LinearElasticity, Classical Fluids, Linear Viscoelasticity

ME 510 Fracture Mechanics (3-0)3

Study of the linear elastic fracture mechanics, stress analysis of cracks, elastic-plastic fracture mechanics, crack growth, fracture mechanisms in metals and non-metals, ductile fracture, cleavage, fracture of plastics, ceramics and composites, fracture toughness testing of metals and non-metals and fatigue crack propagation.

ME 511 Numerical Methods in Mechanical Engineering (3-0)3

Overview of Basic Numerical Methods. Types of Partial Differential Equations. Boundary and Inıtial Conditions. Discretisation process by Finite Differences. Explicit and Implicit Methods. Alternating Direction Implicit Method. Multgrid and Multilevel Methods. General Formulation of Weighted Residual Methods. Finite Volume Method. Finite Element Method and Interpolation. Sturm-Liouville Equation. Spectral Method.

(It will be applied from 2016-2017 Fall)

ME 512 Analytical and Numerical Methods for Phase Change Problems (3-0) 3
Introduction to Phase Change Problems. Exact solution of the problems. Integral Method of Solution. Introduction to Numerical Solution Methods. Temperature Formulation and Enthalpy Formulation. Case Studies.

ME 513 Advanced Composite Techniques (3-0)3
Composite material constituents. Microstructure-performance relationships. Strength of long-fiber composites. Thermoelastic behaviour of laminated composites. Short fiber composites. Hybrid composites. Flexible composites. The interface region, interface formation mechanisms, measurement of bonding strength. Strength and toughness of composites. Processing technologies for polymer, metal and ceramic matrix composites and their applications.

ME 514 Phase Diagrams in Materials Science (3-0)3
High-temperature equilibrium using the laws of physical chemistry as applied to materials systems in both solid and liquid states. An introduction to the crystal chemistry of raw materials, and the effect of crystalline form on their high temperature behavior.

ME 515 Finite Element Analysis in Solid Mechanics (3-0)3
Hybrid-mixed formulation. Beam elements, plate elements, flat-shell elements. Modelling of laminated composites. Small-strain large deflection problems, rigidplastic large deformation problems, large elastic-plastic deformation problems.

ME 516 Finite Element Analysis in Vibrations (3-0)3
Formulation of the equation of the motion. Element energy functions. Finite element displacement method. In-plane vibration of plates. Vibration of solids. Flexural vibration of plates. Analysis of free vibration. Forced response.

ME 517 Advanced Ceramics (2-2)3
Introduction to ceramics. Bonding, crystal structures of ceramic materials, crystal defects, transport, phase equilibrium diagrams, microstructure development, forming, processing and properties. The effects of the composition, for, and source of raw materials on the manufacturing processes and final properties of ceramics. Included are, studies of phenomena such as diffusion, sintering, phase transformation, stability, and microstructural development. Property measurement and analytical methods for characterization are discussed.

ME 518 Analytical Methods in Vibrations (3-0)3
Behavior of systems, Advanced principles of dynamics, Special concepts for vibration study, Natural modes of vibration: Discrete systems-Continuous systems-Approximate methods, Undamped system response, Transform method solutions of continuous systems-Wave solutions, Damped systems, Vibration under combined effects.

ME 519 Advanced Mechanics of Materials (3-0)3
An overview of Mechanics of Materials, Theories of stress and strain, Stress-strain relations, Inelastic behavior, Energy methods, Torsion, Nonsymmetrical bending and shear center of beams, Curved beams, Beams on elastic foundation, Thick-walled cylinders and rotating disks, Stability of columns, Plates and shells.

ME 521 Advanced Thermodynamics (3-0)3
Thermodynamic relations. Mixtures and gas solutions. Gas mixtures. Gas vapor mixtures and air conditioning. Chemical reactions. Introduction to phase and chemical equilibrium. Thermodynamics of high-speed fluid flow. Quantum mechanics. Molecular distributions and models. Statistical mechanics and thermodynamics. Applications of statistical thermodynamics.

(It will be applied from 2016-2017 Fall)

ME 522 High Temperature Materials (3-0) 3

Introduction. Phase equilibrium diagrams of binary, ternary and multicomponent systems. Use of such diagrams for service performance analysis of ceramic materials. Phase assemblage determination by the use of DahI's method. High temperature corrosion of refractory ceramics. Thermal properties of refractory non-oxides like SiC, graphite, etc.

ME 523 Heat Conduction (3-0)3

Heat Conduction Fundamentals. The Seperation of Variables in the Rectangular, Cylindrical and Spherical Coordinate Systems. The use of Duhamel's Theorem. One Dimensinal Composite Medium.

ME 524 Experimental Design (1-4)3

Introduction. Basics of statistics. Use of spreadsheets for laboratory calculations. The nature of experimental variation. Using spreadsheets to make charts and graphs. Introduction to ANOVA tables. Using spreadsheets to analyze Latin-square experimental design, Factorial experimental designs, Box-Hunter experimental designs, and Ruggedness designs.

ME 525 Thermal Radiation (3-0) 3

Ejectromagnetic background. Definitions of fudamental concepts. Interaction of radiation with homogeneous matter. Interaction of radiation with interfaces. Blackbody radiation. Radiation from real surfaces. Radiative energy transfer between surfaces. Radiative energy transfer in enclosures. Radiation in absorbing, emitting homogeneous media.

ME 526 Theory of Turbulence (3-0)3

To demonstrate the derivation of the equations of motions for turbulent flows and to give solid arguments for understanding the mechanisms that become apperant in the equatoions
Disscusion and comprehension of Von Karmans hypothesis and log-law's, Kolmogorov's ideas, and cascade theory, To demonstrate the theory of dynamics of turbulence, To discuss wall bounded and free shear flows, To disscuss and built comprehension for the statistical nature of turbulence, To give theory of Specral dynamics

ME 527 Turbulence-II : Experiments and Computations (2-2)3

Quick recap of the turbulent flows. Fundamentals of common experimental techniques in Turbulence: Hot-wire, Laser Dopler –LDA- and Partical Image Anemometry PIV, Introduction to closure problem and Algebric models, One and Two equation models, Discussion on boussinesq type approximations Introduction to Large Eddy Simulation -LES-

ME 530 Constructal Theory and Design (3-0)3

Flow systems and imperfections. Simple heat flow and fluid flow structures. Multiscale and multiobjective structures. Vascularized materials. Combined mechanical and flow
structures. Animal locomotion (i.e. running, swimming and flying speeds and their relations) and design evolution in competitive sports.

ME 532 Convective Heat Transfer (3-0) 3

Forced convective heat transfer in laminar and turbulent boundry layer flows is studied, as well as internal and external flows with arbitrary variations of surface temperature and heat flux. Exact and approximate formulations using similarity solutions, separation of variables, integral methods and supenposition are investigated. The topics of turbulant transport processes, Reynolds analogy, and emprical results; high velocity flow; heat exchanger, and free convection are also addressed.

ME 534 Advanced Fluid Mechanics (3-0)3

Fundamental concepts. Mathematical preliminarries. Fundamental equations of flow.Analysis of motion. Analysis of forces, stresses. Equations of flow theorems. Incompressible potential flow.

(It will be applied from 2016-2017 Fall)

ME 536 Computational Fluid Dynamics (3-0)3
Governing equations of fluid dynamics, dimensionless form of equations, boundary conditions, simplification of governing equations based on flow type, mathematical classification of flows, vorticity-stream function approach, primitive variable approach, pressure equation, finite difference method, finite difference form of diffusion, convection and source terms, implementation of boundary conditions, finite volume method, SIMPLER algorithm and related procedure, turbulent flows and governing equations, standard k-Є model, grid generation.

ME 538 Acoustic Waves (3-0)3
Fundamental acoustic equations, bulk waves in isotropic and anisotroic madia, waves in plates, surface waves, guided waves in layered structures, simulations and numerical methods

ME 540 Applied Combustion (3-0)3
Combustion theory and practice. Chemical kinetics governing combustion reactions, reaction of droplets and particulate dispersions. Mechanisms and properties of mixing-controlled and reaction-controlled flames. Influence of temperature, extent of mixing and equivalence ratio on combustion efficiency. Radiative heat transfer in combustion systems. Current trends and advanced combustion methods, radiant, heat recirculating, fluidised bed and Coanda burners. Introduction to analysis of combustion processes and combustion technology for gaseous,Iiquid and solid fuels. Application to furnaces, flxed-bed, fluidised-bed and suspension burning boilers.

ME 542 Advanced Combustion in Engines (3-0)3
The lectures will be concentrated on internal combustion engines, in-cy linder measurements and analysis and Computational Fluid Dynamics (CFD) codes and models used in engines research. After a fundamental review of internal combustion engines, students will learn the new technologies associated to engines and the techniques (experimental and numerical) used in engines research.

ME 543 Advanced Technologies for Pollutants Control in Engines (3-0)3
Mechanisms of formation of pollutants.Measure of particles and the gaseous emissions. Gas analyzers and their operation principle. Pollutants formation control in engines. Fuel sprays development and evolution in CI and SI engines.Fuel sprays development and evolution in CI and SI engines. Diesel engines: advanced combustion strategies. Diesel engines: advanced technology. Spark ignited engines: operating modes and stratified charge combustion. Homogeneous Charge Compression Ignition (HCCI) Catalyst systems Hybrid Electric Vehicles (HEV): configurations and control strategies.

ME 545 Direct Use of Geothermal Energy (3-0)3
Introduction to geothermal energy. Geothermal direct use applications in the world. Space heating equipment and space heating systems. Heat exchangers, downhole heat exchangers, piping. Geothermal greenhouse design. Aquaculture. Refrigeration. Industrial usage. Ground-source heat pumps. Environmental considerations. Field trips. Design project.

ME 550 Wind Power (3-0)3
Theory of wind turbines. Theory of wind streams. Types of wind turbines. Design of wind turbines. Wind farms. Economic analysis of wind power plants. Technical potentials.

ME 554 Geothermal Engineering (3-0)3
Introduction to geothermal energy. Fluid flow: fluid mechanics, single phase pipe flow. Cycles: geothermal cycles, exergy. Heat transfer: heat exchangers, downhole heat exchangers. Mass transfer and waste heat rejection: moisture transfer, cooling towers, condensers. Gas extraction. Fiels trips. Design project.

ME 555 Microfluidic Theory (3-0)3
Rewiev of Fundamentals of fluid mechanics; Micro/nano-scale gas flows; Rarefaction effects; Micro-scale liquid flows;Electrokinetic transport phenomena and their microfluidic applications.

(It will be applied from 2016-2017 Fall)

ME 559 Plates and Panels (3-0)3

Plates and panels of isotropic materials; Equations of linear elasticity in Cartesian coordinates. Derivation of the governing equations for isotropic rectangular plates. Solutions to problems of isotropic rectangular plates. Thermal stress in plates. Circular isotropic plates. Buckling of isotropic plates. Vibrations of isotropic plates. Theorem of minimum potential energy, Hamilton's principle and their applications. Reissner's variational theorem and its applications. Plates and panels of composite materials; Anisotropic elasticity and composite laminate theory. Plate equilibrium equations. The bending of composite material laminated plates. Navier and Levy solutions. Transverse shear deformation effects. Elastic instability of composite plates. Linear and nonlinear vibration of composite plates. Energy methods.

ME 560 Sandwich Structures (3-0)3

Sandwich structures: origins, advantages, and uses. Anisotropic Elasticity and Composite Laminate Theory. Derivation of the Governing Equations for Sandwich Plates (Panels). The governing equations for flat sandwich panels. Beams, Columns, and Rods of Composite Materials. Energy Methods for Sandwich Structures. The theorem of Minimum Potential Energy and Reissner's Variational Theorem. Solutions for Rectangular Sandwich Plates. Dynamic Effects on Sandwich Panels. Thermal and Moisture Effects on Sandwich Structures. Thermoelastic problems of sandwich structures, and for polymer matrix materials the hygrothermal considerations.

ME 561 Metal Cutting (3-0)3

Machine tools and machining operations. Mechanics of metal cutting. Temperatures in metal cutting. Tool life and tool wear. Cutting fluids surface roughness. Economics of metal cutting operations. Nomenclature of metal cutting. Chip control, machine tool vibration Grinding. Manufacturing systems and automation. Design for machining.

ME 563 Theory of 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. Introductions to plate theory.

ME 565 Shell Structures (3-0)3

In this course; derivation of the governing equations for thin shells, cylindrical, conical and spherical shells, energy methods, elastic instability and vibration of shells are studied.

ME 567 Robotics Research (3-0)3

Review of robotics: mathematical modeling, components, control and programming. Introduction to research. Research tools. Writing a scientific paper. Evaluation.

ME 568 Mechatronics (2-2) 3

Actuators, intelligent manufacturing systems, analysis and synthesis of intelligent systems, analog/digital circuits, actuator drive circuits, sensors and sensor interfacing (position, velocity, force, tactile and ultrasonic), data acquisition principles, real time programming, microcontroller programming (PIC16F877), overview of man-machine interface systems.
Pre. ME 590 Analytical Methods in Engineering

ME 570 Computational Intelligence (3-0)3

Introduction to conventional AI topics, and recently surging intelligent optimization schemes. From the theory of Neural Networks, to the scheduled cooling in parameter optimization in SA. Inductive and Deductive decision making, simulation of natural processes where nature is at her best : The evolution. It is intended to cover a range of topics from classical to modern computational intelligence.

(It will be applied from 2016-2017 Fall)

ME 571 Kinematic Analysis of Mechanisms (3-0) 3

Basic definitions, introduction to kinematic analysis of mechanisms; Rotation matrices, position analysis of spherical linkages; Homogeneous transformation matrices, Denavit-Hartenberg convention, position analysis of spatial serial chains; Position analysis of parallel manipulators; Lie groups, Lie algebras, screw algebra; Velocity and acceleration analysis with screws; Complex numbers, quaternions, Clifford algebras; Planar kinematic mapping, position analysis of planar parallel manipulators; Spatial kinematic mapping, position analysis of spatial parallel manipulators.

ME 572 Structural Design of Mechanisms (3-0)3

Introduction, definitions; Enumeration of mechanisms and kinematic chains; Type syntesis of parallel mechanisms; Structural synthesis of paradoxical linkages.

ME 573 Deployable Structures (3-0) 3

Types of deploy able structures. Design and analy sis of linkage type planar deploy able structures. Design and analy sis of linkage ty pe spatial deploy able structures

ME 574 Principles of Robotics I (3-0) 3

-Spatial Kinematics- Kinematic Modeling Using the Denavit-Hartenberg Approach- Position, Velocity, and Acceleration Forward and Inverse Analyses- Singularity Analyses.

ME 575 Kinematic Geometry of Robotics (3-0)3

Screw algebra, kinematics of one, two and three screws in space. Recurrent screw descriptions. Screw systems. Screw based Jacobians. Serial and parallel manipulators. Static and dynamic analysis of manipulators.
Pre.ME 571 Kinematic Analysis of Mechanisms /ME 574 Principles of Robotics

ME 576 Computer Control of Machines (3-0) 3

Computer organization: Binary logic1 instruction and data processing. Computer interfacing :Digital-to-analog conversion,analog-to-digital conversion interrupt interfacing.Sensors for computer control. Command generation in machine control: Use for linear and cubic polynomials and spline functions, open-loop position control of step motors.

ME 577 Kinematic Synthesis of Mechanisms (3-0)3

Introduction to kinematic synthesis of mechanisms; Interpolation, Least squares and Chebyshev approximation methods and their application to function generation synthesis; Function synthesis of multi-dof mechanisms; 2 positions of a rigid body in plane; Graphical syntehsis methods; Path generation of planar linkages; Kinematic synthesis of planar linkages with dyads; Dead center design and transmission angle optimization; Kinematic synthesis of spherical mechanisms.

ME 578 Probabilistic Reasoning (3-0)3

Introduction to probabilistic reasoning tools that are prevalent in conventional AI topics. Decision making by often incomplete prior probabilities. Methods to handle inconsistent and ambiguous data. Modeling of sensors and noise. Optimizing sensory data by filters in noisy environments. Entropy as a possible decision making tool in connection with information theory. Probabilistic reasoning is a mathematical way of inference that is already in use as an agent (robot) reasoning, which is the best alternative to rock-rigid deterministic paradigms in a noisy, stochastic agent milieu.

ME 579 Principles of Robotics II (3-0)3

- Overview of Vectors and Fundamentals of Kinematics- Quasi-Static Force/Torque Analysis using Virtual Work Method- Forward and Inverse Dynamic Analyses using the Newton-Euler and Lagrange's Equations- Dynamic Analysis of Serial and Parallel Industrial Robots- Free Position Control of Robot Manipulators- Position Control of Robot Manipulators with Surface Contact. *Pre.- ME571/ ME 574*

(It will be applied from 2016-2017 Fall)

ME 580 Haptics and Teleoperation (3-0)3
Introduction to haptics, Haptics device design, Virtual Reality in haptics, Classification of teleoperation systems, Fault tolerance concept in teleoperation
Parallel position/force controllers, Teleoperation controllers

ME 581 Machine Tool Design (3-0) 3
Types of machine tools. General requirements in the design of machine tools.Geometry and performance of cutting tools. Basic theories of metal cutting. Actuators and drive systems. Slideways. Spindle and spindle bearings. Control and operating devices. Cooling systems. Work holding devices. Machine tool structures. Machine tool dynamics.

ME 583 Industrial Fault Detection and Identification (3-0)3
Introduction to Fault Detection and Identification.General Aspects of Time and Frequency Domain Analyses.Parameter Estimation Methods. Nonparametric Characterization Tools; Entropy Based Methods (Information Theory, FIM),Nonlinear Analyses (Chaos, Fractals), Probabilistic Techniques (Bayesian Decision Theory, etc), Advanced Spectral Analyses (HOS, Hilbert Transform, Bispectrum,Cepstrum, etc). Reliability. Distributed Sensing.

ME 585 Nanomaterials (3-0)3
Challenges in nanomaterials. Bulk nanostructured materials. Nanoscale fillers. Metal nanoclusters.Carbon nanotubes and manufacturing. Nanocomposites. Polymer nanocomposites. Modification of interfaces. Nanoporous structures. Self-assembly films and lithography. Quantum wells, wires and dots. Application of nanomaterials. Characterization and properties of nanomaterials.

ME 587 Microcontroller Embedded Systems (3-0)3
Microcontrollers, embedded control, microcontroller architectures, programming techniques, and a selected physical control application by the student on a specific machine/equipment.

ME 588 Avanced Dynamics (3-0)3
- Spatial Kinematics - Newtonian Dynamics - Dynamics of Rigid Bodies - Dynamics via Work and Energy Principles.

ME 589 Modern Control (3-0)3
- State Space Representation - Solution of State Equations - Controllability and Observability - Lyapunov Stability - Controller Design with State Feedback - Observer Design.

ME 590 Analytical Methods in Engineering (3-0)3
Ordinary differential equations. Series solutions of ordinary differential equations. Method of Frobenius. Laplace transform. Fourier series. Boundary conditions. Partial differential equations. Separation of variables. Bessel, Gamma functions. Legendre polynomials.

ME 591 Special Topics in Mechanical Engineering (2-2)3
Directed group study of special topics in mechanical engineering

ME 598 M.Sc. Research Seminar (0-2)NC
A seminar based on the research subject of own must be given by M.Sc. candidate and graded by supervisor of the thesis on the basis of Satisfactory/Unsatisfactory. Topic of the seminar can be determined either by M.Sc. candidate or his/her supervisor. Academic members of faculty and researchers can be invited to this seminar, aiming to add newer ideas to M.Sc. candidate’s subject.

(It will be applied from 2016-2017 Fall)

ME 599 Methods and Ethics in Engineering Research (0-2)NC

How to conduct a literature survey, how to design a study, how to analyze and present results of a study, how to prepare a manuscript, how the scientific publication system works, conflict of interest, environmental ethics, ethical issues in peer review and publication, human subjects research, research misconduct, responsible authorship, ethics of mentoring, and whistleblowing and obligation to protect the public.

ME 500 M.S. Thesis (0-1)NC

A research topic which can be experimental and/or theoretical has to be pursued. It should fulfill the requirements set by lzmr Institute of Technology Graduate Program

ME 600 Ph.D. Thesis (0-1)NC

Original research work done by the student under supervisor of an advisor and written in the graduate thesis format.

ME 698 Ph.D.Research Seminar (0-2)NC

A seminar based on the research subject of own must be given by Ph.D. candidate and graded by supervisor of the thesis on the basis of Satisfactory/Unsatisfactory. Topic of the seminar can be determined either by Ph.D. candidate or his/her supervisor. Academic members of faculty and researchers can be invited to this seminar, aiming to add newer ideas to Ph.D. candidate's subject.

ME 8XX Special Studies (8-0)NC

Graduate students supervised by the same faculty member study advanced topics under the guidance of their advisor.