ME 110 Comp. for Mech. Engineers (4-0)4 Basic description of computers and peripheral devices, Number systems and flow charting. Programming in Fortran, arithmetic and logic operations, branching, looping, arrays. Program structuring and subprograms. Computational errors. Applications to mechanical engineering problems aiming to orient the student computer user.	**ME 205 Thermodynamics I (4-0)4** Concepts and definitions. Temperature, properties of pure substance, equation of state, heat and work. First law of thermodynamics, internal energy. First law analysis of engineering systems. Second law of thermodynamics. Entropy. Irreversibility and availability.
ME 113 Engineering Drawing I (3-1)4 Geometrical constructions. Orthographic drawing and sketching. Introduction to computer aided drawing. Three dimensional drawings. Dimensioning principles. Sectioning and conventions.	**ME 206 Thermodynamics II (4-0)4** Irreversibility and availability. Power and refrigeration cycles. Thermodynamic relations. Real gases. Mixtures and solutions. Psychometric analysis. Combustion processes. Phase and chemical equilibrium. Flow of compressible fluids. **Prerequest:** ME 205
ME 114 Engineering Drawing II (3-1)4 Screw threads, threaded fasteners. Keys, springs, locking devices, rivets, welding, piping layouts. Gears and cams. Surface quality marks and tolerances. Working drawings, assembly drawings. Introduction to Descriptive Geometry and its engineering applications. **Prerequest:** ME 113	**ME 208 Dynamics (4-0)4** Fundamentals of dynamics. Kinematics of particles and rigid bodies. Newton's second law Dynamics and particles, system particles and rigid bodies. Methods of energy, Momentum. Vibrations. **Prerequest:** ME 201
ME 199 Mech. Eng. Orientation (2-4)4 All Undergraduate student at the and of their first year are required to spend 4 weeks in summer in Mechanical Engineering Department Laboratories and Machine Shop to be oriented in mechanical engineering disciplines (Minimum 4 weeks)	**ME209 Numerical Methods (3-0)3** Description of Numerical Methods and application of them particularly in engineering. Error analyses innumerical methods, analitical solutions, numerical methods for the solution of systems (lineer and nonlinear), approximation methods, interpolation, linear regression, numerical integration.
ME 201 Statics (4-0)4 Idealization and principles of mechanics, important vector quantities, classification and equivalence of force systems, state of equilibrium. Elements of structures: Trusses, beams. Frames and machines. Friction. Variational methods: principles of virtual work and potential energy.	**ME210 App. Math. for Mech. Engineers (3-0)3** An introduction to linear algebra and ordinary differential equations (ODEs), including general numerical approaches to solving systems of equations. Linear systems of equations, existence and uniqueness of solutions, Gaussian elimination. Initial value problems, 1st and 2nd order systems, forward and backwardEuler, and the Runge-Kutta method (RK4). Eigenvalues and eigenvectors, including complex numbers,functions, vectors and matrices
ME 203 Manufacturing Processes I (3-1)4 Classification of manufacturing processes. Basics of engineering materials and raw material production techniques. Basic machine tool elements and mechanics of machine tools. Metal cutting tools and principles of chip removal processes. Production methods of turning, milling, drilling, shaping, grinding, sawing. Gear and thread cutting. Processing of plastics. Economic tool life and machining tune calculations of chip removal processes. Metrology and quality control principles. Special production processes.	**ME 212 Int. to Electromechanical Sys. (4-0)4** Introduction to mechatronics and measurement systems. Electro mechanical systems; pneumatic,hydraulic, electronic circuits and components. Semiconductor electronics. Operational amplifiers. Digital circuits. Actuators. Mechatronic systemscontrol architectures, case studies.

ME 215 Engineering Materials I (3-1)4 Principles of selection of material. Concept of stress and strain in view of material parameters. Properties materials in tension, compression bending. Torsion under combined stress. Residual stresses, fatigue creep, damping, hardness and special properties of material Evaluation of the test results for material selection for different applications.	**ME 305 Heat Transfer (4-0)4** General and particular laws in heat transfer. Steady and unsteady state one dimensional heat conduction. Fundamentals of convective heat transfer. Analogies between heat and momentum transfer. Dimensional analysis and empirical correlations in forced and natural convection. Boiling and condensation. Heat exchangers. Fundamentals of radiation heat transfer.**Prerequest:** ME 205
ME 216 Engineering Materials II (3-1)4 Metals and alloys. Phase diagrams. Production of iron, steel and non-ferrous metals. Steel alloys, nonferrous alloys. Deformation of metals. Failure and testing. Heat treatment of metals. Metallurgy of metal working and fabrication.	**ME 307 Machine Elements I (4-0)4** Fundamentals of element design. Problem breakdown, analysis of alternatives, decision making. Stress analysis. Theories of fatigue, stress concentration. Basic concepts of design: factors of safety, reliability, and standardization. Material selection. Joints: riveted, welded, soldered. Screws and screw fastenings, shafts, keys, pins, springs. Special projects. Prerequest: ME 224
ME 224 Strength of Materials I (4-0)4 External and internal force Stresses in uniaxial and biaxial loading. State of stress and strain principal stresses, Mohr's circle representation. Material properties stress-strain diagrams. Hooke's law. Design load, factor of safety. Failure theories. Bending moment, shearing forces in beams. Moving loads. Properties of cross-section. Flexural stresses. Radius of curvature, elastic curve. Deflection by moment-area method. Statically indeterminate beams. Buckling of columns Torsional moment and torsional displacement. Shafts and helical springs. Strain energy, Castigliano's theorem. Curved beams, rings, thick walled pressure vessels. **Prerequest:** ME 201	**ME 308 Machine Elements II (4-0)4** Antifriction bearings. Hydrodynamic lubrication and journal bearings. Power transmissions and drive systems: Friction drives, belt drives, chain drives, gear drives (Spur, helical, bevel, worm). Couplings, clutches and brakes. Special projects. **Prerequest:** ME 224
ME 301 Mechanisms (4-0)4 Basic definitions for a mechanism and machine, Joint types, Degrees of freedom, cases in which degree-of-freedom equation does not hold true, Grübler type mechanisms and their characteristics, Grübler equation and Number synthesis. Inversion. Position of a point in plane, its velocity and acceleration. Position analysis of mechanisms by analytical method, Freudenstein's equation. Position analysis by graphical means and by analytical geometry. Velocity analysis by analytical means and by velocity polygons. Instant centers, velocity analysis by instant centers. Acceleration analysis by analytical means and acceleration polygons. Gear trains. Basic of cam mechanisms.	**ME 316 Mech. Engineering Laboratory (3-1)4** Experimentation as a subject for study. The nature of engineering experiments. Errors of measurement. Treatment of normal and abnormal error distributions. Error and uncertainty in complete experiments. The design of experiments Aspects of instrument and system design. Test data checking and rejection. Statistical data analysis. Graphical and mathematical data analysis. Techniques of measurement of heating value, temperature, force, speed, power, pressure and flow. Analysis of fuels and exhaust. Determination of absolute and kinematic viscosity, flash and fire points and carbon residue of lubricants. **Prerequest:** ME 305 and ME 371
ME 302 Dynamics of Machinery (3-1)4 Static and dynamic force analysis of planar and spatial mechanisms. Dynamic balancing of rotating masses. Cam dynamics. Gear dynamics. Vibration of mechanical systems Shock isolation. Flywheel analysis. Governors. **Prerequest:** ME 301	**ME 333 Manufacturing Processes II (4-0)4** Foundry processes and special casting processes. Welding and joining processes. Hot and cold working of metals. Sheet metal working.

ME 352 Energy Systems (4-0)4 Fossil fuel systems. Boilers. Solar energy. Wind energy. Hydropower. Geothermal energy. Biomass energy. Nuclear energy.	
ME 371 Fluid Mechanics I (4-0)4 Fluid Statics, Basic Flow Equations, Flow in Closed Conduits, Similarity, Hydraulic Machinery.	**ME 405 Mechanical Vibrations (3-0)3** Review, free and forced vibrations of linear one degree of freedom systems. Vibration measurement. Vibration isolation. Two degrees Of freedom systems. Lagrangian formulation. Non-rigid foundations. Critical speeds. Influence coefficients. Many degrees of freedom. Continuous System: the wave equation, its analytic and graphical solution. Waves. Acoustics vibration of membranes, beams and plates. Advanced topics.
ME 372 Fluid Mechanics II (4-0)4 Flow over submerged bodies. Lift and drag, potential flow theory-equations of motions of viscous Fluids-Laminar Turbulent Flows, Boundary Layer Theory Introduction to I-D compressible fluid flow. Unsteady Fluid Flow Problems. Prerequest: ME 371	**ME 406 Gas Dynamics (3-0)3** Review of basic concepts of thermodynamics and fluid dynamics. Introductory concepts of compressible isentropic flow with area change. Performance of converging and diverging nozzles. Normal shock waves. Moving shock waves. Adiabatic flow in parallel ducts with friction. Isothermal flow in long ducts. Frictionless flow in parallel ducts with heating or cooling.
ME 401 Kinematic Syntheses of Linkages (3-0)3 Four link mechanisms, designed for 2,3,4 and 5 precision coupler link positions and crank angle coordination. Desing for optimumtransmission angle. Cognates, Roberts-Chebyshey theorem. Cam mechanisms, common cam profiles,envelope theory. Intermittent motion mechanisms.	**ME 407 Electrical Act. of Mech. Systems (3-0)3** Principles of electromechanical energy conversion. DC and AC motors. Static and dynamic characteristics of electric motors. Determination of power requirements of non-Linear mechanisms, flywheels. Motor load matching, motor selection criteria. Mathematical modeling of electric motors. Closed loop control of DC motors, components of servo system, feedback elements, position and speed control. Application examples.
ME 402 Industrial Noise and Vibr. Control (3-0)3 Sound levels. Hearing and psychological effects of noise. Noise control criteria. Instrumentation. Sources of noise. Room acoustical materials and structures. Vibration control systems for industrial applications	**ME 408 Strength of Materials II (3-0)3** Review of stress, equilibrium equation. Review of strain, stress-strain relations. Analysis of torsion: non-circular long prisms, torsion stress-function, membrane and fluid-flow analogies, hollow section, multicellular section: Thick walled cylinders, rotating disks of uniform and non-uniform thickness. Membrane stresses. Curved beams. Energy methods.
ME 403 Inventive Problem Solving in Engineering Design (3-0)3 Introduction to Conventional Design and Creative Problem Solving, Problem understanding, Representing and defining the real problem. Pattern breaking, out-of-box thinking. General strategies and inventive problem solving theory Anticipatory failure determination. Introduction to intellectual property, Term Projects.	**ME 409 Machine Design (3-0)3** Factors contributing to the innovation and evaluation of a design. Criteria of elastic failure. Design for fatigue and brittle fracture. Design for creep. Analytical and numerical optimization techniques in design. Simulation and system analysis techniques for design. Introduction to computer aided design. A term project is assigned to each student where creative thinking, proper methods of calculation and a set of technical drawings are the requirements.
ME 404 Gas Turbines and Jet Propulsion (3-0)3 Introduction to propulsion, thermodynamic review, compressible flow, aircraft gas turbine engine, parametric cycle analysis of ideal engines, component performance, parametric cycle analysis of real engines, engine performance analysis, turbo-machinery, inlet nozzles, and combustion systems.	**ME 410 Centr. Pump and Blower Design (3-0)3** Machinery, design of radial-type pumps stage, Other pump impeller types, Pump details and materials, Pump applications and selection, Design of radial-type blower stage. Construction details of blowers, Blower applications

ME 411 Dynamic Systems-Modelling and Analysis (3-0)3 System model representation. Mechanical systems. Electrical and electromechanical systems. Fluid and thermal systems. Systems response. Block diagram representation.	**ME 419 Mechatronics (3-0)3** Introduction to mechatronics and measurement systems. Electric circuits and components. Semiconductor electronics. Operational amplifiers. Digital circuits. Actuators. Mechatronic systems-control architectures, case studies.
ME 412 Hydraulic Machinery (3-0)3 Basic theory of rotodynamic hydraulic machinery. Performance characteristics of pump and hydraulic turbines. Design concepts and applications	**ME 420 Engineering Prof. and Ethics (3-0)3** This course includes; review of the growth and development of the profession, engineering ethics, obligations to employers and peers, limits of professional responsibility, codes of ethics and enforcement, rights of engineers and case studies.
ME 413 Heat Exchangers (3–0)3 Description of direct contact and indirect contact type multifluid heat exchangers(tubular, plate,extended surface,regenerative)Descriptionand thermal analysis of evaporators and condensers. Compact heat exchangers. Effectiveness analysis of heat exchangers.	**ME 421 Biofluid Dynamics (3-0)3** Applications of fluid mechanics to biological systems. Fundamentals of the circulatory system, of the flow properties of blood and of the blood vessels structure. Classical solutions for flow in a tube: Poiseuille regimes, pulsatile flow, flow in an elastic tube and through a converging duct. Non-Newtonian fluids and an overview of peristaltic flow, transport phenomena through porous tubes, and description of heart valves.
ME 414 Internal Combustion Engines (3-0)3 Introduction to internal combustion engines, gas cycles, combustion thermodynamics, fuel air cycles, actual cycles, carburation and fuel injection, fuels of internal combustion engines, engine performance.	**ME 422 Industrial Hydraulics I (3-0)3** Hydraulic power elements, symbols, pumps and motors, actuators, pressure and flow control valves, hydraulic fluid characteristics, introductory control of hydraulic power, examples of industrial hydraulic circuits.
ME 415 Automotive Engineering(3-0)3 Introduction, constraints, vehicle dynamics terminology, acceleration performance, braking brake models, loads during braking, more complete models, ride, stability and concerning, suspension systems, steering, tire models, rolling, directional stability and stability enhancing systems, innovations	**ME 423 Industrial Pneumatics I (3-0)3** Principles of pneumatics, Pascal's law, Gas law, compression and expansion of air, work done during compression, multistage compression. Production and distribution of compressed air, pressure drop in pipes and fitting types and control of compressors, filtering, drying, regulation and lubrication of air, valves, types, specifications and performance. Actuators, motors, their sizing and mounting. Cylinder control in direction and speed, sequential control, signal event charts, cascade circuits.
ME 417 Hoisting and Conveying Machinery (3-0)3 Introduction to material handling. Bulk and unit load concept. Cranes: overhead travelling cranes. FEM rules, calculation methods for bridge girders, and carriages, drive and hoist mechanisms, and related equipment. Jib cranes, gantry cranes. Feeders and conveyors, roller conveyors, pneumatic conveyors, vibrating conveyors, screw conveyors..	**ME 424 Internal Combustion Engine Design (3-0)3** Thermodynamic analysis and actual performance parameters of internal combustion engines, design of internal combustion engine components, vibration analysis. balancing of internal combustion engines, design of a typical diesel engine.
ME 418 NC and CNC Fundamentals (3-0)3 Features of the NC and CNC machine tools, and processing units. Part programming principles. Programming for NC and CNC controlled machine tools.	**ME 425 Systems Dynamic and Control (3-0)3** Introduction to control system. Review of Laplace transformation. Mathematical modeling of dynamic systems. Fundamentals of system dynamics. Block diagrams. Transfer functions. Linearization of non-linear systems. Performance of dynamic systems. Time-domain performance specification, transient and steady state characteristics of linear systems. Stability analysis of linear systems. General discussion of feedback control systems

ME 426 Control Systems Design (3-0)3 Introduction to control systems design. Discussion of basic control types. Root locus analysis. Frequency response analysis. Stability in the frequency domain. Principles of design of control systems. Compensation techniques. The use of analogue computers in the simulation of control system. A term project is assigned to each student where creative thinking and proper methods of design are the prime requirements	**ME 431 Transport Technology (3-0)3** Functions and advantages of transportation. Transport characteristics of people and goods. Qualities of efficient transport services. Forms of transport and types of service, technical and cost aspects.
ME 427 Int. to Control System Technology (3-0)3 Basic concepts and requirements from a control system. Types of control, transducers for kinematic and dynamic quantities and operations. Amplifiers, conventional control strategies and their mathematical modeling, interfacing. Handshaking. A/D and D/A conversion, comparators and switching. Final control elements.	**ME 432 Finite Elem. Tech. in Mechanics II (3-0)3** A brief description of finite element method (FEM), Finite element modeling techniques of Solid Structures using a commercial finite element software package, Stress analysis of engineering problems in two and three dimensions, Comparison of the finite element and analytical solutions, Interpretation of results.
ME 428 Robotics (3-0)3 Brief history, present state. Degrees Of freedom, manipulator configurations, end effectors. Basic drive systems. Forward and inverse kinematics, generalized velocity and force relations, static force analysis. Trajectory planning. An overview of mechanics and control. Manipulator dynamics using Newtonian and Lagrangian approach. Hints on numerical solutions of motion equations. Control problems, sensors, position and force control. Robot programming languages.	**ME 433 Elementary Optimal Design (3-0)3** Optimization as an element of the engineering design process. Case studies that demonstrate the theory and application of non-linear programming as a design tool. Comparative examination of unconstrained algorithms. Development and application of methods for the constrained case. Selected contemporary topics
ME 429 Introduction to Composite Materials (3-0)3 Element of Composite materials; metal-matrix composites; Laminated composites; Natural composites; mechanical properties of composites; strength of composites; analysis methods of composites; applications and of composite materials to various areas.	**ME 434 Exergy Meth. for Energy Sys.(3-0) 3** Fundamentals of Engineering Thermodynamics. First Law of Thermodynamics. Second law of Thermodynamics. Entropy and Entropy Generation. Exergy Concepts: Reversible Work, Exergy, Irreversibility, and Second Law Efficiency. Chemical Exergy, Exergy Transfer Associated Heat Transfer and Fluid Flow. Energy and Exergy Analyses of Thermal Systems: Actual Case Studies. Energy and Exergy Analyses of HVAC Systems. Basic Principles of Exergy Economics. Life cycle Analysis and Sustainability.
ME 430 Finite Elem. Tech. in Mechanics I (3-0)3 Basic concepts of finite–element method, the potential energy approach, interpolation function, derivation of elements stiffness matrix, assembly of the global stiffness matrix, treatment of boundary conditions, applications to engineering problems such as One-D, truss, axisymmetric and Two-D elasticity problems.	**ME 435 C/C++ Prog. for Mech. Engineers (3-0)3** An overview of C/C++ programming; variables, constants and operators; program control statements; arrays and strings; pointers; classes; virtual functions; I/O system. Object-oriented programming concepts. Solutions of problems related with mechanical engineering using Visual C++.

ME 436 Pipeline Engineering (3-0)3 Theoretical and practical aspects of pipeline engineering including pipeline transport of liquids, gases and various solids such as coal, sand solid wastes. Newtonian and non-Newtonian fluid flow in pipe, Two-phase flow in pipe, pipe fittings, valves and pressure regulators, Automatic control systems, Protection of pipelines against freezing, abrasion, and corrosion. Planning, construction and operation of pipelines, Structural design of pipelines, Economics of pipelines. Legal, safety and environmental issues on pipelines, Standards and government regulations	**ME 440 Heat Pump Systems (3-0)3** Basic heat pump systems and applications, heat pump components. Gas fired and hybrid heat pumps. Energy use determination, Comparative energy studies. Economics of heat pump systems.
ME 437 Insulation (3-0)3 Theoretical and practical aspects of heat and noise insulation in engineering applications. Heat loss calculations in pipes, automobiles, structures, etc., Insulation materials, Insulation applications on roof, wall and floor, prevention of sweating and condensation in rooms, Prevention of freezing in pipes, Insulation in channels of air-conditioning units, Sound and heat insulation in automobiles, Noise insulation in machines, houses, Workshops, factories etc. Standards and government regulations related with heat and noise isolation	**ME 441 Automobile Engineering I (3-0)3** Components of the automobile. Motion and modeling of the vehicle. Maximum speed and acceleration calculations. Wheels and tires. Brake systems and braking performance. Suspension systems and suspension geometry. Steering systems and steering geometry. Aerodynamic drag coefficient and its effect on vehicle performance.
ME 438 Theory of Combustion (3-0)3 Scope of combustion. Combustion thermodynamics. Chemical kinetics in reaction rate. Explosions in gases. Laminar and turbulent flames in premixed combustive uses. Structure of detonation. Diffusion flames; liquid droplet combustion. Theory of thermal ignition. Combustion of coal; burning rate of ash forming coal; pulverized coal combustion. Combustion generated air pollution; pollutant formation mechanisms. Equilibrium and frozen flow; propellants and rocket propulsion.	**ME 442 Automobile Engineering II (3-0)3** Tires, Wheels, Axes and balance rod, steering systems, suspension systems, seats and safety systems, vehicle rides, vehicle body constructions.
ME 439 Fund. of Object Oriented Prog. (3-0)3 Review of scalar and structured data types Object oriented programming concepts: Classes and abstract data types, inheritance, polymorphisms, operator overloading. Classical and object oriented program specification, design, coding and testing. Linear (stacks, queues, Linear lists) and nonlinear data structures (trees, sets); sequential and random access files. Implementation of data structures; Linked lists multidimensional arrays, records, character strings, stacks, queues, trees and sets. Recursion. Basics of visual programming. Engineering Applications.	**ME 443 Mathematica® For Engineering (3-0)3** Mathematica® as an interactive symbolic calculator, graphics, algebra and calculus, solving equations, solving Equations, solving differential equations and PDE, lists, matrices, transformation rules, functional operations and pure functions, introduction to programming, Mathematica® packages such as discrete mathematics, linear algebra, numerical mathematics, statistics. Applications to engineering problems

ME 444 Matlab® For Engineers (3-0)3 Matlab® as an interactive symbolic calculator , graphics, algebra and calculus, solving equations, solving equations, solving differential equations and PDE, lists, matrices, transformation rules, functional operations and pure functions, introduction to programming, Matlab® toolboxes regarding discrete mathematics, linear algebra, numerical mathematics, statistics. Applications to engineering problems.	**ME 449 HVAC Engineering I (3-0)3** Air conditioning systems, moist air properties and conditioning processes, comfort and health, heat transmission in building structures, solar radiation, space heat load, the cooling load.
ME 445 Solar Energy Engineering I (3-0)3 Solar radiation, available solar radiation, selected topics in heat transfer, radiation characteristics of opaque materials, radiation transmission through covers, flat plate collectors, concentrating; collectors.	**ME 450 HVAC Engineering II (3-0)3** Design of pipe systems, room air distribution, building air distribution, mass transfer and the measurement of humidity. Direct contact heat and mass transfer, extended surface heat exchangers
ME 446 Solar Energy Engineering II (3-0)3 Storage system thermal calculations, solar processes economics, solar water heating, design of solar heating systems, passive solar heating, solar cooling, solar Industrial processes heat, thermal design methods, conversion to mechanical energy, evaporative processes and salt gradient ponds.	**ME 451 Thermal Power Engineering (3-0)3** Energy sources, utilization, economics, and terminology, principal fuels for energy conversion. Production of thermal energy. Fossil fuel systems.Nuclear reactors Enviromental impacts for power plants. Production of mechanical energy. Energy storage.
ME 447 Micro-Thermofluid Technology (3-0) 3 The Technology Related to Microfluidics is Introduced. The Basics of Theoretical Foundations and Technological State of art are Given. Synthesis Based on Previous Undergraduate Curriculum on Thermalfluid Sciences is Aimed.	**ME 452 Energy Management (3-0)3** Principles of energy management. Energy reserves of Turkey. Energy economics and energy consumption in Turkey. Energy conservation in engineering applications. Energy and cost effective combustion techniques. Thermo-economics of insulation applications. Energy cost and efficiency of industrial furnaces. Energy conservation in electrical systems. Alternative energy sources. Environmental impacts of energy consumption. Cogeneration systems. Economics of energy recovery systems.
ME 448 Computer Controlled Design and Measurement in Flow Systems (3-0) 3 Fundamentals of LabView Software Program or Any Kind of Data Flow Programming. Navigating a Software Program for any Kind of Fluid Mechanics. Thermodynamics and Energy Case Studies. Knowledge on Front Panel, Block Diagram, Dataflow. Building a Simple Program. Troubleshooting and Debugging. Implementing a Program. Relating Data. Common Design Techniques. Synchronization Techniques. Event Programming. Error Handling. Controlling the User Interface. File I/O Techniques. Creating a Project-Case Study. Acquiring, Processing and Post-processing Data in the Related Research Fields.	**ME 454 Refrigeration (3-0)3** Thermodynamics analysis of single stage and multistage vapor compression systems. Refrigerants, compressors, evaporators, condensers. Expansion devices and auxiliary equipments. Balance and automatic control of complete system. Absorption refrigeration, thermo-electric refrigeration. Applications of refrigeration. Introduction to cryogenics.

ME 455 Natural Gas Technology (3-0)3 Introduction to natural gas industry, natural gas in Turkey and in the world, gas markets and supply economics, natural gas pricing. Chemical composition and fluid properties of natural gas, thermo-physical and transport properties of natural gas, estimation of heating value. Equations of state and thermodynamic properties. Exploration of operations and techniques, drilling operations, characterization of reservoirs, types of natural gas reservoirs, production of a natural gas reservoir. Separation of condensates, purification operations, hydrocarbon liquids recovery, acid gas removal, natural gas liquefaction, LNG loading, transport and storage, natural gas transport in pipelines and storage, natural gas processing equipments and treatments, oil and gas separators, gas compression and coolers. Domestic and industrial outlets, electricity production, co-generation, air conditioning, natural gas for vehicles (NGV).	**ME 470 Corrosion and Surface Treatment(3-0)3** Introduction to corrosion, Factors influencing corrosion, specific corrosion types, methods for combating corrosion, surface treatments including mechanical surface treatment and coating, surface hardening by heat treatment and thermal spraying, vapor deposition, ion implantation, diffusion coating. Electrochemical plating, electrolysis plating, anodizing, conversion coating, hot dipping etc.
ME 460 Fundamentals of Aerodynamics (3-0)3 Fundamentals of inviscid incompressible flow. Airfoils-wings and other aerodynamic shapes. Incompressible flow over airfoils Incompressible flow over finite wings. Subsonic compressible flow over finite wings: Linear Theory. Elements of airplane performance and propulsion.	**ME 471 Production Engineering (3-0)3** Classification of production and types of layouts. Economics of production: cost estimating, break-even analysis, economic batch size, and selection of machinery. Ergonomics, time and motion study, process operation analyses and flow charts. Specification and standardization for production.
ME 461 Non-Trad. Man. Methods (3-0)3 CNC, rapid prototyping, flexible manufacturing system (FMS), electro discharge machining (EDM), laser cutting, water jet cutting, surface treatments, powder metallurgy, ultrasonic friction welding, agile manufacturing, e-manufacturing, manufacturing by artificial intelligence.	**ME 472 Engineering Metrology and Quality Control (3-0)3** Fundamental of measurement. Linear, angular measurements. Limits and limit gauge design. Machine tool metrology. Gear and thread measurement. Measurement of surface texture and roundness Statistical quality control charts, acceptance sampling
ME 465 Computational Fluid Dynamics Applications in Engineering (3-0) 3 Fundamentals of Fluid Mechanics. Introduction and Fundamentals of CFD. Basic Overview of Meshing Software and Creating Basic Geometry. Grid Generation and Grid Independence. Basic Overview of Solver Software. Cell Zones and Boundary Conditions. Solver Settings. Laminar Modeling. Turbulence Modeling. Transient Folw Modeling. Postprocessing. Related Workshops.	**ME 473 Welding Technology (3-0)3** Practical and theoretical aspects of welding, types of welding, effects of welding, stresses, distortion, welding of casting, reactive metals, steels and non-ferrous materials, design for welding, quality control.

ME 475 Computer Aided Design and Drafting (3-0)3 Introduction to Computer Aided Design. CAD hard wares and soft wares. Basic drawing features. Advanced drawing features. Wire frame modeling, surface modeling, solid modeling. Parametric and variational design.	**ME 480 Textile Engineering I (3-0)3** Brief introduction to various phases of textile industry: Classification and properties of textile materials, textile processing. Cotton processing Basic principles involved in cotton spinning; carding, drafting, combing, drawing, rink spinning. Preparatory processes: chase and cone winding, warping, pin winding. Basic operations of weaving; utilization of weaving; utilization of weaving cycle, weft insertion, shedding beat-up, let-off, take-up, control mechanisms. Shuttless looms. Knitting, weft knitting, warp knitting, mechanical limitations to productivity of weft and warp knitting.
ME 476 Introduction to Operation Research (3-0)3 Linear programming product mix problems, product scheduling problems, transportation method, transshipment problem, simplex method, assignment problems, integer programming, travelling salesmen problems, network planning; CPM, PERT line balancing problem; some heuristic methods, line of balance (LOB).	**ME 481 Textile Engineering II (3-0)3** Case studies in textile engineering: Calculation of yarn tension during ring spinning, mechanics of spinning balloon, effects of traveler mass and shape on spinning conditions. Primary aspects of power loom design: dynamics of picking mechanisms, dynamic and stability of positive let-off motions, shedding cams, spring under motions, design considerations of beat-up mechanisms, rapier drive mechanisms, process of cloth formation, control of fabric structure.
ME 477 Factory Design (3-0)3 Introduction to factory design and materials handling. Information sources for factory design. Factory location. Time study. Process design. Assembly and pack-out analysis. Flow analysis techniques. Charts for factory design. Space requirements in factory design. Employee services. Materials handling and materials handling equipments. Designing the factory layout. Cellular manufacturing and flexible manufacturing systems. Applications of computer simulation and modeling to factory design. Factory design project.	**ME 482 Rapid Product Development and Manufacturing (3-0)3** Scope of the product development and manufacturing, fundamentals of product development, product development techniques, rapid product development, measurement techniques, remodeling and reconstruction, conventional and advanced manufacturing methods, rapid manufacturing methods, rapid tooling.

ME 478 Prin. of Die Design and Man. (3-0)3 Introduction to die forming methods. Basic components of metal-working dies. Basic die design requirements. Die materials. Methods of die manufacturing. Essentials of die-to-press relationships	**ME 485 Cost Engineering (3-0)3** Importance of cost estimating. Engineering design and modeling. Patterns of cost estimating. Methods of cost estimating. Operation estimating, product estimating, project estimating and system estimating. Optimization with engineering-economics boundaries. Management of cost estimating.
ME 486 The Prep. and Eva. of Inves. Pro. (3-0)3 Basic economic concepts related to investment projects. Preparation of projects in economics terms. Demand analysis. Analysis of economic size and location. Technical aspects of project preparation. Financial aspects of project preparation: Calculation of capital requirements: financing budgeting organizing, pricing break-even analysis, and the problem of productivity. Evaluation of investment projects.	**ME 493 Industrial Hydraulics II (3-0)3** Introduction of fluid and control technology, closed-loop hydraulic circuits and their elements, structure and functions of proportional valves, fundamental proportional hydraulic control circuits, position control circuits in closed cycles, signal flow diagrams, applications.
ME 488 Maintenance Engineering (3-0)3 Maintenance mathematics; Maintenance managment and control; Engineering and analysis toos; Preventive maintenance ; Maintenance of mechanical equipments; Maintenance of the machine tools; Human error in maintenance; Quality and safety in maintenance	**ME 495 Man. Methods of Plastics(3-0)3** Plastic materials, thermosettings, thermoplastics and elastomers, chemical and physical properties, uses, Methods of processing, compounding and pre-forming, molding, injection extruding. Calendaring, casting, lamination blowing.
ME 490 Agricultural Machinery I (3-0)3 Physico-mechanical properties of soils. Primary tillage equipment. Tillage force analysis and hitching. Secondary tillage equipment. Planting equipment. Spraying and dusting equipment. Crop-processing equipment. Labor saving equipment..	**ME 497 Jig and Fixture Design (3-0)3** Purpose of tool design. Types and function of jigs and fixtures. Supporting and locating principles. Clamping and work-holding principles. Basic Construction principles design economics. Developing the initial design. Tool Drawings. Template jigs. Vise-held and plate fixtures. Plate jigs. Angle-plate jigs and fixtures. Channel and Box jigs Vise-jav jigs and fixtures. Power work-holding. Modular Work-holding. Welding and inspection tooling. Low-Cost jigs and fixtures. Tooling for numerically controlled machines. Setup Reduction for Work-holding. Tool Materials.
ME 491 Agricultural Machinery II (3-0)3 Cleaning and grading agricultural products. Physical and mechanical properties affecting grading of farm produce. Flat separating surfaces. Airflow systems. Cylindrical grader. Operation and operating conditions of machines. The drying processes. Thermal properties of agricultural materials. Green crop dries.	**ME 499 Graduation Project (4-0)4** A term project is assigned to each student where he/she can employ his/her background knowledge in the design or investigation of a system

ME 492 Industrial Pneumatics II (3-0)3 Pneumatic logic, Boolean algebra and application to pneumatic systems, truth tables and Karnaugh maps, sequential control. Electro-pneumatic circuit elements, switches, solenoids and relays, relay logic cascade electrical circuits for automation in pneumatics. Programmable logic controllers, timers. Design of fully automatic circuits, air operated tools. Safety rules, faultfinding and maintenance.	**ME 400 App. Eng. Education** Engineering applications, Internship proctices. Innovation, Project development and management. New system and product design. Research development and technology management. Business planning commer cialization. Technology foresight and forcasting.Technology assesment. Process analysis principles af business. Business and administration diciplines safety. Comminication in business life.