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## ME Department -B.Sc. Course Description

### **0904131 Engineering Graphics**

3 Credit Hours

Prerequisite: None

Drawing equipment and use of instruments. Lettering, Geometric construction, Sketching and shape description. Basic descriptive geometry, Developments and intersections. Axonometric, oblique and perspective drawings, Multiview projection, Principal views, Conventional practice, and sectional views. Auxiliary views. Dimensioning techniques. Parallel: Introduction to computer drawing, Drawing aids, Geometrical construction, and the appropriate commands of text, editing, plotting, sections, layers, pictorial views, and dimensioning. Auxiliary views.

### **0904202 Computer Programming for Engineers**

2 Credit Hour

Prerequisite: 1901102

A systematic development of programming via flowcharts and pseudo codes; The course highlights include: assignment, repetition, decision making, arrays, file processing and subprograms in program construction. Program design includes: algorithm design, procedures and data program structure, module design, programming standards, program documentation, testing, debugging, verification and validation, file organization and processing, array processing, abstract data structures, data driven programs and simulation. Matlab language will be used. Homework problems and projects of direct engineering applications will be assigned.

### **0904221 Engineering Mechanics**

3 Credit Hours

Prerequisite: 0301101+0302101

Force systems; resultant, moment of a force, equivalent force-couple system. Particle and rigid body equilibrium in one plane. Trusses and Frames. Beams; shear force and bending moment diagrams. Center of gravity and centroid. Area moment of inertia. Planar kinematics and kinetics (Newton's second Law and work-energy method) of particles and rigid bodies in rectilinear and curvilinear motion (normal and tangential coordinates).



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**0904222 Dynamics** 3 Credit Hours

Prerequisite: 0901242

Kinematics of particles; Rectilinear and curvilinear motion in various coordinate systems. Kinetics of particles; Newton's second law, Central force motion, Work-energy equation, Principle of impulse and momentum, Impact, Conservation of energy and momentum, Application to a system of particles. Kinematics of rigid bodies; Relative velocity and acceleration, Instantaneous center, Analysis in terms of a parameter. Plane kinetics of rigid bodies with application of Newton's second law, Energy and impulse-momentum.

**0904233 Machine Drawing** 1 Credit Hour

Prerequisite: 0904131

Mechanical engineering drawing conventions and abbreviations, various systems of size description, including precision dimensioning, fastening elements, standard organization and preparation of engineering drawings, assembly and detailed drawings, design applications.

**0904248 Thermal and Fluid Science** 3 Credit Hours

Prerequisite: 0302102

Introduction. Basic principles of thermodynamics, fluid mechanics and heat transfer. Thermodynamics concepts and definitions. Properties of pure substances, First law of thermodynamics. System and control volume analyses. Second law of thermodynamics. Basic principles of fluid mechanics. Fluid statics. Conservation laws. Energy equations. Flow in pipes. Heat transfer modes. Conduction, convection and radiation.

**0904249 Thermal and Fluid Science Lab.** 1 Credit Hour

Prerequisite: 0904248

Liquid-vapor saturation curve. Flow through a nozzle. Heat pump and air-cooler. Friction and secondary losses in pipes. Hydrostatic pressure on a plane surface. Impact of water jet. Pump characteristics. Flow visualization. Thermal conductivity measurement.



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**0904302      Engineering Numerical Methods      3 credit Hours**

Prerequisite: 0904202

Mathematical preliminaries, numerical errors and, loss of significance and error propagation. Numerical solution of nonlinear algebraic equations, Review of linear algebra (Solution of systems of linear equations). Numerical solutions of systems of linear and non-linear algebraic equations. Interpolation and approximation and curve fitting. Numerical differentiation and integration. Numerical solution of differential equations. Eigen value problems. Introduction to numerical solution of partial differential equation. Applied examples from various areas of engineering.

**0904312      System Dynamics and Vibrations      3 Credit Hours**

Prerequisite: 0301202

Modeling of mechanical systems (using Newton's second law and energy method). Modeling electrical, thermal, fluid and mixed systems. Examples and applications of Block diagrams system representation and simulation (Simulink or Labview). Review of Laplace transforms, Laplace based analysis of first, second and higher order systems (transient and steady state) in time and frequency domains (frequency response functions). Case studies: base motion, rotating unbalanced, suspension system, ... etc.

**0904314      Dynamics and Vibrations Lab.      1 Credit Hour**

Prerequisite: 0904312

Static and dynamic balancing. Centrifugal force. Simple and compound pendulums. Bifilar suspension. Center of percussion. Kater's reversible pendulum. Torsional oscillations of single and two rotors system. Vibration of a rigid body spring system. Undamped vibration absorber. Dunkerley's equation.

**0904331      Mechanics of Machinery      3 Credit Hours**

Prerequisite: 0904222 or 0904312

Mechanisms and applications, mobility and linkages. Cams, gears and gear trains. Velocity and acceleration analysis in mechanisms. Inertia forces. Principles of balance in rotating & reciprocating masses.



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0904341      Thermodynamics (1)      **3 Credit Hours**

Prerequisite: 0302102

Thermodynamic concepts and definitions, states, properties, systems, control volume; processes, cycles, and units; pure substances, equation of states, table of properties; work and heat; the first law, internal energy and enthalpy; conservation of mass; SSSF and USUF processes; the second law, heat engines and refrigerators, reversible processes, Carnot cycle; entropy, Clausius inequality, principle of the increase of entropy, Efficiencies.

0904342      Thermodynamics (2)      **3 Credit Hours**

Prerequisite: 0904341

Review of basic laws and principles. Irreversibility and availability, Vapor and air power and refrigeration cycles. Mixtures of real gases and vapors. Psychrometry. Combustion. Elementary chemical kinetics

**0904345      Thermodynamics Lab.**      1 Credit Hour

Prerequisite: 0904341 + 0904342 or Co-requisite

Experimental methods in the following : Mechanical equivalent of heat; The adiabatic exponent; Marcet boiler; Bomb calorimeter; Flow through nozzle; Refrigeration system; Air conditioning system; Heat pump and air cooler; single stage air compressor; cooling tower; Thermic unit (steam turbine power plant).

**0904349      Technology of the Built Environment.**      3 Credit Hours

Prerequisite: None

Heating and Air conditioning, Psychrometry, Heating and cooling, Load calculations, Heating networks, Boilers, Radiators, Pumps, Air conditioning, Air distribution and domestic hot water. Building sanitary systems, cold water networks, pumps, fire fighting networks and drainage systems and materials. Lifts design, load, speeds and control systems. Elevator room dimensions .



**0904361 Fluid Mechanics (1)**

3 Credit Hours

Prerequisite: 0901202 or co-requisite

Introduction, Fluid properties, Basic units. Fluid statics, Pressure and its measurements, Forces on plane and curved submerged surfaces, buoyancy & floatation, Fluids in motion, Flow kinematics and visualization, Basic control volume approach, Differential and integral continuity equation. Pressure variation in flowing fluids, Euler's and Bernoulli's equations, Applications of Bernoulli equation. Momentum principle and its applications, Navier-Stokes equations. Energy equation, Hydraulic and energy grade lines. Dimensional analysis and similitude. Surface resistance and introduction to boundary layer theory. Flow in conduits, laminar and turbulent flows, Frictional and minor losses, Piping systems.

**0904362 Fluid Mechanics Lab.**

1 Credit Hour

Prerequisite: 0904361

Experimental methods in the following systems : center of pressure; impulse momentum principle; pumps, friction losses in pipes, stream lines and flow fields, buoyancy and boundary layer theory. Radial flow fan, Water turbine, Flow measurement.

**0904372 Strength of Materials (1)**

3 Credit Hours

Prerequisite: 0901241 or 0904221

Axial loading, Material properties obtained from tensile tests, Stresses and strains due to axial loading, Thermal Stresses, Elementary theory of torsion, Solid and hollow shafts, Thin-walled tubes, Rectangular cross-section, Stresses in beams due to bending, shear and combined forces. Composite beams, Analysis of plane stress, Mohr's Circle, Combined stresses, Thin-walled pressure vessels, Deflection of beams, Buckling of columns, Energy Methods.

**0904374 Material Lab.**

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Credit Hour

Prerequisite: 0904372+0906275\*

This laboratory serves mainly the measuring and/or determination of some material properties (strain and stress, yield stress, ultimate stress, fracture stress). Non destructive testing of materials (NDT), micro and macro examination of materials and phase diagrams for steel. It is equipped with machines for conducting tests, such as: Tension, impact fatigue, bending, creep, hardness, and photo elasticity tests.



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**0904411 Mechanical Vibrations** 3 Credit Hours

Prerequisite: 0904222+ 0301202

Simple harmonic motion. Elements of vibratory systems. Systems with single degree of freedom and applications; damped free vibration, rotating and reciprocating unbalance, vibration isolation and transmissibility, and period excitation, systems with multiple degrees of freedom and applications, methods of finding natural frequencies.

**0904412 Mechanical Vibrations Lab** 1  
Credit Hour

Prerequisite: 0904411

Static & dynamic balancing, centrifugal force, simple & compound pendulum, bifilar suspension, mass spring system, damping coefficient and logarithmic decrement. center of percussion, kater's reversible pendulum, torsional free vibrations, resonance response of a single degree of freedom system. Base excitation and vibration isolation.

**0904418 System Dynamics and Control** 3 Credit Hours

Prerequisite: 0301202+ (0904222 or 0904312)

Review of complex variables and Laplace transform .Poles and element transfer function and block diagram. Modeling of physical systems; electrical, mechanical, hydraulic and pneumatic systems. Linearization of nonlinear systems. System representations. Thermal, System block diagrams and signal flow graphs. Overall transfer function, block diagrams reduction techniques and Mason's gain formula. Time response analysis and performance indices of first and second order systems. Dominate poles of high order systems. Routh-hurwitz stability criterion. Stability analysis using root locus. Bode diagrams and Nyquist stability criterion. Introduction to analysis using state-space equations.

**0904419 Control Lab.** 1 Credit  
Hours

Prerequisite: 0904418

The lab consists of experiments that are related to: First and second order system analysis control experiments. Servo systems. Stability of dynamical systems. System identification. Design and tuning of a PID controller in closed loop systems. Simulation of systems using Simulink or Matlab.



**0904422      Engineering Measurements      3 Credit Hours**

Prerequisite: 0904361+ 0904418

Report writing, basics of metrology, inspection and measurements. Errors & error analysis, uncertainty analysis, statistical methods, least squares method. Basics of transducers. Static and dynamic characteristics of systems. Measurement of flow, pressure, and temperature. Strain gauges, strain rosettes.

**0904424      Engineering Measurements Lab.      1      Credit**  
Hours

Prerequisite: 0904422\*

Experimental methods on the following systems: pressure measurement, flow measurement, temperature measurement, strain gauges, strain rosettes.

**0904435      Machine Design (1)      3 Credit Hours**

Prerequisite: 0904372

Meaning, phases, evaluation, considerations of design, stress analysis, deflection analysis, static strength and theories of failure, fatigue strength. Design of fasteners and connections; riveted joints, bolts and screws, force-deflection diagrams of bolted connections. Welded joints. Mechanical springs, helical, leaf, torsional spring shafts.

**0904436      Machine Design (2)      3 Credit Hours**

Prerequisite: 0904331+ 0904435

Rolling contact bearings, selection, mounting and enclosure. Lubrication and journal bearings. Clutches, coupling and brakes. Gearing : Geometry, kinematics gear trains and force analysis. design of spur, helical, bevel and worm gears. multi-speed gear boxes. design and analysis of belts, ropes, chains, term project.

**0904437      Design of Machine Elements      3 Credit Hours**

Prerequisite: 0904372

Review of stress, analysis. Theories of failure. Power transmission shafts. Tension and shear. Connections and selection of bolts. Helical tension and compression spring design. Weld analysis and design. Selection of rolling element bearings. Gears geometry, Force and stress analysis. Mechanical couplings. Flexible power transmission elements.



**0904441 Heat Transfer -1** 3 Credit Hours

Prerequisite: 0301302+0904361

Introduction to modes of heat transfer; one-dimensional steady state conduction; unsteady state conduction, lumped heat capacity system; introduction to convection, flow and thermal boundary layers. laminar and turbulent boundary layers; convection in internal and external flows; empirical relations for forced convection heat transfer; natural convection systems; condensation and boiling; introduction to thermal radiation.

**0904443 Thermal Power Plants** 3 Credit Hours

Prerequisite: 0904342

Review of power cycles related to steam and gas turbine power plants; types and characteristics of steam power plants including various plant components; water treatment; corrosion; load management; power plant economics. Environmental aspects.

**0904445 Air Conditioning -1** 3 Credit Hours

Prerequisite: 0904342+ 0904441

Review of psychrometry; thermal comfort; air conditioning processes; inside and outside design conditions; heating load calculations, infiltration; cooling load calculations, solar gain; heating systems, design, layout; hot water, steam, hot air systems; under floor heating.

**0904446 Heat Transfer lab.** 1 Credit Hour

Prerequisite: 0904441

Experimental work in heat transfer covering: Measurement of thermal conductivity, Natural and forced convection, Radiation, Boiling and condensation. Heat exchangers.

**0904453 Refrigeration Systems** 3 Credit Hours

Prerequisite: 0904342

Basic definitions and concepts; review of vapor compression and absorption cycles; compressors, condensers, evaporators, expansion devices; refrigerants; cooling towers; components of an absorption cycles, controls.





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- 0904459 Energy Conversion** 3 Credit Hours  
Prerequisite: 0904342  
Energy classification, sources and utilization; Energy growth and economics; Fossil-Fuel Systems and combustion in steam power plants. Steam generators. Boiler rating and performance. Environmental aspects of thermal power plants. Overview on renew-able energy sources with emphasis on solar and wind energy systems. Introduction to direct energy conversion systems; Thermoelectric, photovoltaic and thermionic converters. Energy Storage.
- 0904462 Fluid Mechanics -2** 3 Credit Hours  
Prerequisite: 0904361  
Review of basic definitions; system and control volume; Foundations of flow analysis; differential form of the basic laws; general viscous flow; boundary layer theory, Navier – Stokes equation, Blassius equation, Von Karman equation, Irrotational flow; stream function, vorticity and rotationality, Incompressible inviscid frictionless flow, 2-D Flow solutions around bodies, compressible flow; adiabatic and isentropic flow; Normal shock waves; Nozzles; Introduction to turbomachinery, centrifugal pumps.
- 0904466 Turbomachinery** 3 Credit Hours  
Prerequisite: 0904342, 0904361  
Review of basic thermodynamics and fluid mechanics; types of turbomachines; 2-D cascades; Principles of operation of compressors and pumps; centrifugal pumps, axial-flow pumps, axial-flow turbines; and radial-flow turbines.
- 0904467 Design of Sanitary Systems** 3 Credit Hours  
Prerequisite: 0904361  
History of plumbing systems, Basic definitions; Water sources, water quality and treatment, drinking water quality. Basic fluid mechanics principles, building cold water supply systems and design, building hot water supply systems and design. Valves in water supply systems and selection, plumbing materials; plumbing fixtures. Building soil and waste drainage systems (internal and external), traps, clean-outs, interceptors, and back water valves; indirect waste piping and special wastes; drainage systems design; vents and venting; design of storm water drains; building fire fighting systems.
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**0904472      Strength of Materials -2      3 Credit Hours**

Prerequisite: 0904372

Non-Linear behavior of materials, dynamic & repeated loading, stress concentration, stresses in initially curved beams. Deflection of beams, moment-area method, Three-Moment equation, strain-energy method. Statically indeterminate beams, theory of columns. Energy methods in applied mechanics.

**0904481      Failure and Fracture Analysis      3 Credit Hours**

Prerequisite: (0904372)

Role of failure prevention in Mechanical design. Stress and deformation. Classical theories of failure. Notches and notch sensitivity. Fracture Mechanics: Rowan –Irwin relationship, Linear elastic fracture mechanics, Elastic stress field approach, Energy balance approach, J-Integral. Fatigue: Low cycle fating, High cycle fatigue, and remaining life. Creep and some mathematical; models. Wear.

**0904484      Computer-Aided Design      3 Credit Hours**

Prerequisite: 0904372 + 0904331

Fundamentals of Hardware and Software. Techniques for Geometric Modeling (Line, Surface and Volume Modeling). Elements of Interactive Computer Graphics. Entity Manipulation. Introduction to Finite Element Techniques. Using in-house software: Introduction to Graphics User Interface, Sketcher Environment, Parametric & Feature-Based Solid Modeling, Surface Modeling, Concept of Parent/Child Relationships, Part Construction Techniques, Patterns, Advanced Features, Cross-Sections, Parametric Relations, Component Assembly Techniques, Drafting (Drawing) Techniques, Animation, Introduction to Mechanism Design and Analysis, Introduction to Structural and Thermal Simulation.

**0904493      Introduction to Finite Element Method      3 Credit Hours**

Prerequisite: 0904302

**Introduction and basic concepts of finite element method. Finite element formulation and stiffness matrix. One-dimensional elements (spring, bar and beam elements) Two-dimensional elements (Plane triangular element). Finite element analysis of vibration, heat transfer, fluid flow, and thermal stress problems. Discussion.**



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**0904521      Robotics      3 Credit Hours**

Prerequisite: 0904331+ 0904418

Introduction and robot application, kinematic configuration, kinematic analysis, forward & inverse dynamic analysis. Lagrange formulation, Newton-Euler Method. Path planning and motion programming. Robot arm control. Robot languages. Vision systems.

**0904536      Design of Mechatronics Systems      3 Credit Hours**

Prerequisite: Consent of Department

Mechatronic design projects combining theoretical and practical applications with real world constrictions. The designs are to incorporate sensors, actuators, microprocessor interfacing, PLC, and computer control. A formal report and demonstration setups are part of the course requirements.

**0904537      Design of Hydraulic and Pneumatic Systems      3 Credit Hours**

Prerequisite: 0904418 or 0908441

The objective of this course is to familiarize student with fluid power systems design control and operation. It covers the fundamentals of fluid flow, modeling and n port concepts, fluid power modulation, static and dynamic modeling of pumps, motor, control valves, transmission lines and fluid drives. It also deals with design control and operation of mechanical and electrical hydraulic servodrives with feedback. Emphasis is placed on linear hydraulic systems behavior.

**0904538      Applications in Mechanical Design      1 Credit Hours**

Prerequisite: 0904436

A project oriented course aimed at applying the design and selection techniques covered in machine design courses into an integrated project. Students work in teams on real life mechanical design problems.

**0904541      Air Conditioning (2)      3 Credit Hours**

Prerequisite: 0904445

Review of psychrometry; analysis of inside and outside design conditions; low speed air conditioning systems; cooling coils, basic cooling load analysis; by-pass systems; single duct, double and multi-duct systems; unit location and position funding; duct design, fans, energy; ventilation; control systems.



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**0904542 Heat Transfer (2) 3**

Credit Hours

Prerequisite: 0904441

Review of basic concepts; radiation properties and processes; radiation exchange among surfaces; two dimensional steady state conduction; analytical, graphical, and numerical solutions; one-dimensional transient conduction; topics in convective heat transfer; exact and approximate problem solutions, combined entry length solution in pipe flow; heat transfer in turbulent and high speed flows; liquid metal heat transfer; freezing, melting, heat-pipe heat transfer; multimode heat transfer.

**0904545 Internal Combustion Engines 3 Credit Hours**

Prerequisite: 0904342

Fundamentals of engines and their types. Review of air-standard, fuel-Air and actual cycles. Fuel and combustion. Fuel feeding systems. Engine testing and performance characteristics. Air pollution. Forced induction systems. The course also includes an experimental part which allows the student to estimate the performance of both spark ignition and compression ignition engines, effect of some parameters on engine performance like ignition timing, Air/Fuel ratio, compression ratio and perform an energy balance of the compression ignition engine.

**0904554 Solar Energy 3 Credit Hours**

Prerequisite: 0904441

Fundamentals of solar radiation; methods of solar radiation collection; thermal systems components and analysis; transfer of collected heat; storage of collected heat; domestic hot water system; introduction to solar energy applications.



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**0904580 Modern Control Systems. 3 Credit Hours**

Prerequisite: 0904418

State variable representation of systems, Steady state and transient response specifications, Control design to satisfy stability and time response specification, control design to satisfy stability and time response specifications, linear transformations, controller design via state space methods. Controllability and Operability, control design via poleplacement, sensitivity analysis, introduction to system identification, and stability analysis of linear systems using Lyapanov method.

**0904582 Vibration and Noise Control 3 Credit Hours**

Prerequisite: 0904411

Nature and propagation of sound, Measurement of sound, Sound Absorption, room acoustics sound Isolation, Mechanical systems Noise and vibration, control of noise in machinery and Enclosures design, Measurements of Vibrations, Vibration Isolation and control of vibration in machines. Discussion.

**0904583 Autotronics 3 Credit Hours**

Prerequisite: 0904545+0904418

Design and control of Fuel Feeding system, Ignition system, Suspension system, Steering system, Brake system, Differential gear box, Navigation system, Air conditioning and Car safety.

**0904594 Selected Topics in Thermal Sciences 3 Credit Hours**

Prerequisite: Consent of Department

**The contents of this course are outlined after the approval of the department council.**

**0904596 Selected Topics in Applied Mechanics 3 Credit Hours**

Prerequisite: Consent of Department

**The contents of this course are outlined after the approval of the department council.**



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**0904599 Project**

3 Credit Hours

Prerequisite: Successful completion of 124 Cr.Hr.

The project extends over a two-regular-semesters period. In the first semester, students (individually or in teams) are assigned engineering problems which may be theoretical, experimental or both and contains a major design component. In the first semester, the students study the problem assigned and its theoretical background, set the approach, conduct a literature review, make the problem analysis and preliminary design and write a proposal including a cost estimate and time table for implementation over the second semester. In the second semester, the students carry out detailed design, construction and testing (if any), write a comprehensive report on the work as per the format posted on the department web site. The report should include, where applicable, economical and environmental assessments. The project work is presented by the students to an examination panel who judge the work.