Syllabus of Mechanical Engineering Courses
Technical Language
1.In this coarse students will learn academic writing
Metal Forming
1.Metal Forming Concepts, Anisotropy **2.Mechanical Behavior, Super Plasticity** **3.Metallurgy of Metal Working Process: Rolling** **4.Forging, Extrusion, Drawing & Sheet Forming** **5.Friction & Lubrication** **6.Thermo-mechanical Process** **7.Slab Method Analysis** **8.Drawing**
Vehicle Chassis Design
1.History **2.Inflatable tires** **3.Functional characteristics** **4.Travel convenience features** **5.Maneuver characteristics** **6. Suspension systems** **7.Steering systems**
Robotics
1.Introduction **2.Spatial Descriptions and Transformations** **3.Kinematics; Forward & Inverse** **4.Jacobians: Velocities and Static Forces** **5.Dynamics**
Finite Element Method
1.Introduction **2.Direct stiffness method for bar elements** **3.Development of truss elements** **4.Development of Beam elements** **5.Frames and Grid Equations** **6.Development of Plane stress and Plane strain** **7.Stiffness Equations** **8.Applications of 2D analysis and its limitations** **(Development of 2D elements CST, Quad, Axisym)** **9.Isoparametric Formulation** **10.3D stress analysis** **11.Plate Bending** **12.Heat and mass transfer** **13.Thermoelasticity**
Design of Control Systems
1.Fundamentals of signals and systems **2.Controller Design in Frequency Domain**
Computer-Aided Design & Manuring
1.Introduction to CAD /CAM **2.Hardware and Sofware of a CAD System** **3.Various Data Base and Data Structure**

Product Data Exchange
4.Introduction to 3D Geometric Modelling
5.3D Wire-Frame Modelling
6.3D Surface Modelling
7.3D Solid Modelling
8.Introduction to Curve Equations
9.Cubic Spline, Hermit and Bezier Curves Equations
10.CAM and G-Code Generation
11.CNC Control Strategies CAPP systems
12.Adaptive Control
13.Geometric Transformation

Statics

1.Fundamentals of Mechanics
2.Vector properties and Elements of Vector Algebra
3.Equivalent Force Systems
4.Truss Analysis
5.Analysis of Chains and Cables
6.Analysis of Chains and Cables
7.Section Forces in Beams, Shear Force and Bending Moment Diagrams
8.Friction Forces
9.Properties of Surfaces
10.Methods of Virtual Work and Stationary Potential Energy

Engineering Design Methods

1.Design methods and Strategies
Systems and Product Design Process: Conceptual design, Preliminary design Detail design, and Evaluation
2.Methods of improving Creativity: Braking psychological sets, Brainstorming, Inversion, Analogy, Morphological charts
3.Decision Making: under risk and uncertainty, Concept of utility, Decision matrix, AHP technique
Material Selection: Screening, Comparing and optimum Selection
4.Optimization Techniques: Differential calculus and Lagrange Multipliers, Numerical methods, Simplex algorithm, and Geometric Programming
5.Fundamentals of Economic Analysis: Compound Interest Rate, Cost comparing, Inflation and Depreciation
6.Project Planning: Critical path method
7.Probability and Engineering Statistics: Probability 8.Theorems, Frequency Distributions, Regression analysis
9.Reliability Evaluation of Engineering Systems: Mathematical model, Failure rate,Reliability analysis of simple and complex systems
10.Human Factors: Anthropometric factors, Physical factors, Sensory factors, and Psychological factors.

Thermodynamics (I)

1.Introducing the method of studying the properties of different materials
2.Introduction to work and heat
3.The first law of thermodynamics for a closed system
4.The first law of thermodynamics for control volume
5.Qualitative expression of the second law of thermodynamics
6.Entropia
7.The second law of thermodynamics for a closed system

8.The second law of thermodynamics for control volume **9.Analysis of various developments using the law** **10.The efficiency of compression and expansion machines** **11.Workability**
Dynamics (I)
1.Particle Kinematics **2. Particle Kinetics** **3. Planner Kinematics and Kinetics of Rigid Bodies**
Strength of Materials (I)
1.Stress and strain-axial loading **2.Torsion** **3.Pure bending** **4.Design of beam for bending-** **5.Shear stress in the beam and thin cylinder**
Strength of Materials (II)
1.Deflection and slope calculations using direct integration, moment-area, and superposition methods indeterminate beams. **2.Deflection and slope calculations using direct integration, moment-area, and superposition methods in indeterminate beams. Deflections and slope calculations due to temperature change and axial displacements in determinate and indeterminate beams.** **3.Columns: Stability of Equilibrium, Euler Buckling formula for pin end, one end clamped and one endpin, clamped ends and one end clamped columns, beam-column analysis, columns under eccentric loadings, the Secant Formula, Generalized Euler Buckling-Load formula** **4.Energy Methods: Elastic strain energy in simple tension, pure shear, pure bending and torsion, Design of Energy Members, Principle of Virtual Work, Unit-Load Method, Castigliano's Theorem for determinate and indeterminate beams.** **5.Failure Criteria: Tresca Yield Criteria, von Mises Yield Criteria, Maximum Normal Stress Criteria, and Mohr Criteria.**
Fluid Mechanics (I)
1.Introduction **2.Basic concepts** **3.Fluid kinematics** **4.The Bernoulli equation** **5.Fundamental principles** **6.Finite control volume** **7.Dimensional analysis and similarity**
Dynamics of Machinery
1.Definitions and basic concepts **2.Instant center of rotation** **3.Speedology by the method of instantaneous centers** **4.Speedology by the method of relative velocities**
Thermodynamics (II)
Research Method & Report Writings
1.Academic writing **2.Report writing**

3.Book writing **4.dissertation writing** **5.Technical report writing** **6.Lecturing skills**
Science of Materials
1.Introduction **2.Atomic Structure and Interatomic Bonding** **3.The Structure of Crystalline Solids** **4.Imperfections in Solids** **5.Diffusion** **6.Mechanical Properties of Metals** **7.Dislocations and Strengthening Mechanisms** **8.Failure** **9.Introduction** **10.Corrosion**
Fluid Mechanics (II)
1.internal incompressible viscous flow- **2.External incompressible viscous flow** **3.Fluid machinery** **4.Incompressible viscous flow** **5.Open channel flow** **6.Compressible flow**
Design of Machine Elements (I)
1.Fundamentals of Engineering Design **2.Review on Mechanic of Solids** **3.Failure theories for variable loading** **4.Failure theories for variable loading** **5.Shaft Design** **6.Design of Permanent Joints (Welding)** **7.Design of Non-Permanent Joints (Rivets, bolts, and nuts)** **8.Design of Power Screws** **9.Design of Mechanical Springs**
Mechanical Vibrations
1.Free Vibration of Single DoF Systems **2.The vibration of Multi DoF Systems** **3.Introduction on Vibrational Systems** **4.Harmonic Forced Vibration of Single DoF Systems** **5.General Forced Vibration of Single DoF Systems** **6.The vibration of Two DoF Systems**
Heat Transfer (I)
1.Introduction **2.Introduction to Conduction** **3.One-Dimensional, Steady-State Conduction** **4.Two-Dimensional, Steady-State Conduction** **5.Transient Conduction** **6.Introduction to Convection**
Design of Component (II)
1.Journal bearings and lubrication **2.Roller bearings**

3.Spur gears **4.Helical gears, Bevel gears,Worm gears types and other** **5.Belt and chains** **6.Brakes and clutches** **7.Axisymmetric problems in the Design of machines** **8.Fitsand limits**
Dynamics (II)
D Kinematics of a rigid body, translation, fixed axis rotation **Rotation about a fixed point, general motion** **general motion, rotating reference axis, Euler angles** **D Kinetics of a rigid body, angular momentum, mass moment of inertia tensor۳** **Motion Equation, Eulers equations** **Kinetic Energy, Principle of Work and Kinetic Energy,** **D motion about a fixed point** **Torque free motion** **The motion of an asymmetric top** **Gyroscopic motion** **Analytical dynamics: generalized coordinates and degree of freedom** **Virtual displacements, virtual work, generalized forces** **The principle of virtual work** **Lagranges equations**
Heat Transfer (II)
1.A general introduction to the syllabus, references and evaluation approach **2.Derivation of natural convection governing equations** **3.Analytical solution of natural convection equations** **4.Natural convection correlations for various geometries (part 1)** **5.Natural convection correlations for various geometries (part 2)** **6.Solving some problems with natural convection** **7.duction to various boiling mechanisms, different types of boiling regimes, and investigation of non-dimensional numbers in convective heat transfer in presence of phase change** **8.Investigation of correlations for nucleate and film boilings, and introduction to two-phase flow** **9.Introducing different types of condensation mechanisms, an analytical solution of film condensation and investigation of film condensation correlations** **10.Mid-term Exam** **11.Investigation of fundamental concepts in radiative heat transfer, different types of radiation intensity functions and introduction to radiation spectrum** **12.Investigation of the black body energy spectrum, Stefan-Boltzmann law, and band emission functions** **13.Investigation of emission, absorption, reflection and transmission from real surfaces and their corresponding coefficients; investigation of gray surfaces** **14.Shape factor concept and its calculation for a multi-surface cavity, and black body radiation exchange** **15.Radiation exchange between gray surfaces in an enclosure, investigation of two-surface enclosures, and radiation thermal circuit** **16.investigation of radiation shields and reradiating surfaces; Multi-mode heat transfer analysis**
Automatic Control
1.Introduction and Mathematical Modelling of Control Systems

2.Mathematical Modeling of Mechanical Systems and Electrical Systems **3.Mathematical Modeling of Fluid Systems and 4.Thermal Systems** **5.Transient And Steady-State Response Analyses** **Control Systems Analysis and Design by the Root-Locus Method** **6.Control Systems Analysis and Design by the Frequency-Response Method** **7.PID Controllers**
Power Plant Engineering
1.Introduction to Steam Power Plants **2.Fuel and combustion** **3.Boiler** **4.Suction and chimney** **5.Cooling units in the power plant** **6.Condenser** **7.Feeding water heaters** **8.Water purification techniques** **9.Steam turbines** **10.Arrangement of steam power plant cycles** **11.Arrangement of steam power plant components** **12.Energy balance on the cycle**
Turbomachinery
1.Axial Turbines **2.Axial Compressors** **3.Radial Equilibrium** **4.Pumps** **5.Centrifugal Compressors**
Design of Heat Exchangers
1.Introduction of the class and its rules / Application of heat exchangers in industry / Lesson outline / Guidance and its application in fins **2.External convection / Simple and finned pipe handles** **3.External convection/heat transfer inside the tube / Classification of heat exchangers** **4.General Theory of Heat Exchangers / Analysis of Parallel Flow Converters** **5.Analysis of parallel current converters/converter impact factor and effective parameters on it** **6.Heat Exchanger Performance Charts / Application Problem Analysis Using General Converter Theory** **7.Familiarity with the structure of different types of heat exchangers** **8.Design of Double tube heat exchanger** **9.Design of Shell and tube heat exchanger** **10.Design of plate-fin heat exchangers** **11.Design of Frame-plate heat exchangers**
Air Conditioning Systems
1.Chapter one:Heat exchange of the human body with the environment and air conditioning **2.Chapter two: Steps of designing and calculating air conditioning projects** **3.Chapter three: Humid air processes (psychrometer),4 sessions** **4.Chapter four: Heating load estimation, 3 sessions** **5.Chapter five: Heating systems selection, 3 sessions** **6.Chapter six: Cooling load estimation, 4 lectures** **7.Chapter seven: Cooling apparatus, 2 lectures** **8.Chapter eight: Cooling apparatus selection, 2 lectures**

9.Chapter nine: Air distribution system design, 4 lectures **10.Chapter ten: Steam system design, 4 lectures** **11. Visit**
Gas Distribution Network
1.SECTION ONE: House Gas piping Design; six weeks lectures **2.SECTION TWO: City Gas Piping Network Design; 8 weeks lecture**
Refrigeration Systems
1.Introduction, textbook, and references, topic and evaluation (1 session) **2.Refrigeration system design, challenges, approaches and applications (2 sessions)** **3.Simple refrigeration cycle (4 sessions)** **4.Cascade refrigeration cycles (3 sessions)** **5.Liquefaction cycles (2 sessions)** **6.Midterm exam (1 session)** **7.Refrigeration load calculation (4 sessions)** **8.Evaporators (3 sessions)** **9.Compressors (2 sessions)** **10.Condensers and cooling towers (4 sessions)** **11.Refrigerants (1 session)** **12.Control and capacity matching (2 sessions)**
Strength of Materials (III)
1.Theories of Stress and Strain **2.Linear Stress-Strain-Temperature Relations** **3.Torsion** **4.Rotating Disks** **5.Fracture Mechanics** **6.Fatigue** **7.Creep** **8.Inelastic Material Behavior** **9.Applications of Energy Methods** **10.Bending of Straight Beams** **11.Beams on Elastic Foundations**
Mechanics of Composite Material
1.Introduction to composites (Definition and classification - Constituent structures - Particle composites - Layered composites - Fiber composites - Expanded composites - Factors affecting the properties of fiber composites - Familiarity with manufacturing methods) **2.Summary of mechanical properties of fiber composites (strain stress curve of components of a composite material - Simple theory for long fibers - Mechanism of continuous fiber reinforcement - Short fibers and their resistance mechanism - Composites with a random distribution of fibers - Introduction to the effects of pressure - Fiber direction Different failure modes)** **3.Anisotropic elasticity (elastic stiffness and compatibility matrix in non-isotropic materials - materials in different states of elastic symmetry - Physical concept of elastic tensor coefficients of an orthotropic material - Investigation of thermal and moisture properties of composites)** **4.Micromechanics (Law of Mixtures - Modules of Longitudinal and Transverse Elasticity - Sheer Elastic Modulus - Transverse Shear Modulus - Longitudinal and Transverse Poisson Coefficients - Coefficients of Thermal and Moisture Expansion - Thermal Conductivity - Moisture Infiltration)** **5.Specific heat - modified law of mixtures - quasi-experimental relations**

6.Analysis of composite and multilayer layers (composite layers - multilayers - contracting and coding of laminates - multilayer equations - special laminates) **7.Analysis of sheets made of composite materials (sheet equilibrium equations - bending of composite sheets - sheet boundary conditions - Navier-Stokes solution for composite sheets)** **8.Beams, columns and rods made of composite materials (equations of symmetrical beams - another theory for bending and stretching of layered beams - simple tension - simple bending - calculation of displacement in bending)** **Thermal stresses (governing relations - method of solving thermal stress problems - thermal stresses in orthotropic sheets)** **9.Strength of laminates (strength criteria in single layers): maximum stress** **10.Maximum strain - Sai and Hill - Quadratic reaction - Laminate design using fracture criteria)** **11.Screwing and Composite Tank Design (Introduction to Screwing Method - Advantages and Disadvantages - Screwing Technique - Movement Axes - Types of Screw Machines - Production Process - Patching Patterns - Mandrels - Final Baking - Installation of Clamps and Fittings - Theory for Design Twisted strands - Design of composite tanks - Unit load method - Reliability - Calculation of incoming loads)** **12.Joints in composite structures (mechanical joints - adhesive joints - advantages and disadvantages - design - different methods of repair)**
Fuels & Combustion
1.Introduction **2.Combustion thermodynamics** **3.Combustion kinetics** **4.Mass transfer** **5.Governing equations** **6.An introduction to the simulation of combustion systems**
Gas Turbines & Jet Engines
1.Types of airplanes jet engines and gas turbine power plants
Engineering Drawing (I)
Engineering Drawing (2)
Air Pollution Control
1.Introduction to particle transfer- their pollution and their control **2.Introduction to fluid mechanics and looking to two-phase flows** **3.Particle dynamics** **4.Cont.. of particle dynamics** **5.Cont.. of particle dynamics** **6.Measurement and distribution of particle size** **7.Introducing the measuring equipment** **8.Calculating the efficiency of capturing** **9.Looking to particulate control- settling chamber** **10.Cyclone design** **11.Design of electrostatic precipitator** **12.Filters** **13.Scrubbers** **14.Looking at problems in air pollution controls**

15.Seminars in new attempts **16.Overall views and closing**
Fundamental and principles of Solar
1.Different sources of renewable energy. **2.Sun its structure and amount of energy component of solar energy.** **3.Geometrical aspect of sun and earth, the atmospheric effect on solar radiation component.** **4.Solar collectors, types, and theoretical aspects of energy collections, methods of efficiency increase.** **5.Selective surfaces, principles, and applications.** **6.Photovoltaic effect, basic principles, and applications.** **7.Efficiency calculation parameters encountered in performances.** **8.Solar cooling processes.** **9.Basic principles and performance, method of improvement for solar water desalination.** **10.Basic principle and performances of solar** **11.Dryers, Sterling cycles in the conversion of heat to mechanical and electrical energy.** **Solar concentrators' applications and types.** **12.Technical, economical and cultural aspects and environmental concerns of solar energy applications.**
Water Supply Systems
1.introduction and Design of Water Supply Systems **2.Introduction to Qanats** **3.Hydrology** **4.Hydraulics** **5.Basic Principles of Flow in Pipe** **6.Analysis of Flow Net** **Case Studies in Water Transfer**