# المحتوي العلمي للمقررات الدراسية لجميع الشعب بقسم ميكانيكا الطيران والقوى والانتاج

# Description of Courses Content for All Sections in Mechanic of Aeronautic, Power and Production Engineering Department

**MGE 221 Strength of Materials I (3 Units) Prerequisite: GE 140, GS131**

Stress-strain concept - Stress-strain relationship - Shear stress-strain - Hooks law - Stresses in composite bars - Thermal stresses - Application to the simple problems of statically determinate and statically indeterminate problems - Theory of thin cylinders - Stress-strain analysis - Moher circuses - Simple theory of beams - Shear force - Bending moment diagram - Simple theory of torsion.

**MGE 224 Engineering Mechanics II (3 Units) Prerequisite: GE 140**

Kinematics: Rectilinear translation - Curve linear translation - Curvilinear motion - Application to simple engineering problems - Kinetics: Newton's laws of motion - D-Alemberts principle and application to problems - Moment of inertia of area and masses of various regular bodies - Rotation of rigid bodies - Plane motions and application - Work – energy methods for particles and rigid bodies - Power and impulse momentum - Mechanical vibration.

**MGE 211 Mechanical Drawing (2 Units) Prerequisite: GE 142**

The theoretical part: Understanding the most important topics like - Fasteners (Bolts & Screws) - Locking aids - Keys & Feathers - Splint shafts – Rivets - Weld representations - Gear representations - Marking of metals - Surface roughness - Grades of accuracy - Fits &Tolerances - PIN & ISO- Standards - The practical part: Assembly and detailed drawings of some mechanical parts that have to cover the mentioned topics - Computer applications of engineering drawing (AutoCAD).

**MGE225 Materials Science (2 Units) Prerequisite: GS 131**

Introduction – Types – Structure properties – Strength to weight ratio - Atomic arrangement – Unit cells – Allotropic transformation - Atomic movement in materials – Diffusion – Fick's second law – Kirkendall effect – Solidification and grain size – Strengthening – Slid solution strengthening – Deformation strain hardening and annealing

(cold and hot working) – Dispersion strengthening by phase transformation and heat treatment.

**MGE 231 Fluid Mechanics I (3 Units) Prerequisite: GS131 & GS121**

Introduction in fluid mechanics – Definitions and units – Fluid properties – Fluid hydrostatic – Fluid dynamics – Flow of ideal incompressible fluids – Boundary layer - Impact and momentum principles – Similarity and dimensional analysis – Fluid flow in pipes – Flow measurements – Computer applications in fluid mechanics

**MGE 261 Theory of Machines I (2 Units) Prerequisite: MGE224**

Fundamental concepts - Properties of motion relative motion – Linkages - Instant Centres - Velocities by instant centres and by components - Method of relative velocities - Acceleration in mechanism - Kinematics of gear mechanism - Gear trains and non-standard gears - Cams: types of cams - Motion of cams: simple harmonic – Parabolic - Cycloidal motion - Construction of cam profile – tangent - Circular and polynomial cams - Belts drives - Static force and moment analysis; analytical and graphical methods - Superposition principle - Dynamic analysis - Dynamic of rigid bodies - Centre of percussion.

**MGE 381 Basics of Electrical and Electronics Eng. (3 Units) Prerequisite: GS120 & GS130**

Analysis of DC circuits using Kirchhoff's laws, Thevenin's, Norton's and Superposition theorem, A.C fundamental, Generation of alternating emf, Analysis of R-L, R-C and R-L-C circuits, Series and Parallel resonance, 3-phase star and delta connected systems, Power and Power factor. The direct current – Electrical circuits theories – Delta and star junction and the conversion between them–Continuous sinusoidal AC circuits – Solving using time vectors – Electrical power and power coefficient in AC circuits – Three phase current – Electrical machines – DC machines – Electrical transformers – Synchronize machines – Induction machines – Small power motors. Conductors and semiconductors – Diodes and its applications – Bipolar transistor – Field effect transistor – Basic amplifier transistor circuits – Feed and biasing transistors – Small signals transistors models – One stage amplifier analysis.

**MGE 341 Thermodynamics I (3 Units) Prerequisite: GS131 & GS121**

Basic concepts of thermodynamics - Ideal and actual gases – Mixtures of gases – The first law of thermodynamics – The basic processes of ideal gases – The second law of thermodynamics – Entropy – Availability – The thermodynamic probability – Differentials thermodynamic relationships – Thermodynamic property relations – Properties of pure substance - The thermodynamic properties of materials – Vapor processes – Heat flow processes.

**MGE 364 Machine Design I (3 Units) Prerequisite: MGE211 & MGE221**

Process of Designing - Recording the design ideas - Forms of the design documentation - Design analysis -Optimum design - Stress and external loads - Stress concentration - Safety of factors - Stress as function of time - Fracture: Fatigue analysis - Bolted joint - Welding joint - Riveted joints - Screw joints - Power screws - Tolerances and fits in connections - Shaft design - Hub-shaft joints Combined load - Combined stresses.

**MGE 375 Production Engineering I (3 Units) Prerequisite: GE 244**

Mechanical working of metals, hot and cold working. Metal forming processes and equipment: Rolling, Forging, Extrusion, Drawing. Introduction and classification of machine tools, cutting tools and their materials, cutting fluids.

**MGE 314 Quality Management (3 Units) Prerequisite: ---**

Quality and global competitiveness - Quality management and ethics - Quality culture - Customer satisfaction and retention - Employee empowerment - Leadership and change - Team building and teamwork - Education and training - Overcoming politics - Negativity and conflict in the workplace - ISO9000 and total quality.

**MGE 316 Industrial Organization and Works Management (2 Units) Prerequisite: MGE315**

Introduction and definitions – Industrial Organization as control-architecture and functional-architecture – Industrial managements: types, principles, elements, functions. [The main five functions] – General overview about the following scientific managements: Process management (operation & maintenance planning and management) – Product management - Manpower (human recourses) management – Materials and logistics management - Expenses in industry and costs management - Applications and used technologies.

**MGE 343 Heat Transfer I (3 Units) Prerequisite: GS222 & MGE341**

Introduction on modes of heat transfer – Conduction – Convection and radiation - Conduction heat transfer energy equation – Steady-state conduction - Heat transfer with varying conductivity – One-dimensional conduction heat transfer in cartesian and cylindrical coordinates – Conduction heat transfer with heat generation - Extended surfaces (fins) – Principles of convective heat transfer – Dimensionless analysis of forced convection heat transfer – Natural convection systems.

**MGE 382 Automatic Control (3 Units) Prerequisite: GS222 & MGE224**

Review of math – Tools - Complex number and Laplace transformation - Introduction to the control systems and classification - Mathematical modeling of dynamic systems - Block diagram and their algebra - Performance of the open and close loop control systems - Stabilities of linear close loop system - Root locus methods and application - Frequency response methods - Stability on frequency domain - Design and compensation of feedback control systems. Transient response analysis, 1st order system, 2nd order systems using MATLAB with Simulink.

**MGE 474 Corrosion Engineering& Protection (3 Units) Prerequisite:---**

Definition, Electrochemical Nature of Corrosion, Thermodynamics Aspect of Corrosion, Forms of Corrosion, Corrosion Control: material selection, design, inhibitors, coating, cathodic and anodic protection.

**MGE 385 Engineering Measurements (2 Units) Prerequisite: MGE 231 & MGE 341**

Fundamentals of measurements – Characteristics of Measurement system – Classifications of measuring devices – statistical analysis of experimental data – Multipurpose measuring transducers – Electrical indicators – Pressure measurements – Flow measurements – Temperature measurements – Transport properties measurements – Time, velocity, and acceleration measurements – Force, torque, and power measurements – The linear measurements – Analogue devices (mechanical, electrical and fluids pressure) – Angles measurements – Fits and Tolerances - Design of instruments and measurements systems.

# المحتوي العلمي للمقررات الدراسية الخاصة بشعبة هندسة ميكانيكا القوى
# Description of Courses Content for Mechanic Power Engineering Section

**MPE 444 Heat Transfer II (2 Units) Prerequisite: MGE 343**

Multidimensional conduction heat transfer - One-dimensional unsteady conduction heat transfer – Forced convection - External and internal flows - Momentum and thermal boundary layers analysis (momentum integral method) – Natural convection - Boiling heat transfer - Nucleate boiling - Film boiling – Condensation heat transfer - Condensation, turbulent and laminar film condensation on surfaces – Heat exchanger and its types – Logarithmic mean temperature difference calculation – Fouling resistance - Heat exchanger design - Thermal insulation – Types - Properties and selection methods of insulating materials.

**MPE 432 Fluid Mechanics II (2 Units) Prerequisite: MGE 231**

Introduction in fluid dynamics – Physical laws in fluid mechanics field – Reynolds transport theorem – Analysis of some engineering applications by control volume method – Deducing the Navier-Stock's equations - The use of Navier-Stock's equations in solving some engineering applications – Boundary layer theory – Boundary layer solution using Von-Karmen equations - Potential flow theory and its applications, using conformal mapping - Computer applications in the field of fluid mechanics.

**MPE 442 Thermodynamics II (2 Units) Prerequisite: MGE 341**

Mixture: General consideration - Dalton's - Amagat model of a mixture of gas and a vapor - Psychometric chart - Combustion: Fuels - Combustion process - Enthalpy of formation - Adiabatic flame temperature - Heat of reaction - Bomb and Juncker's calorimeters - Thermodynamics cycles: Carnot - Rankine – Reheat – Otto – Diesel – Dual – Brayton – Vapour - Compression refrigeration - Ammonia-absorption refrigeration cycles - Thermodynamics relations: Maxwell relations - Relations involving, Enthalpy, Internal energy and Entropy - Thermodynamics tables.

**MPE 462 Theory of Machines II (2 Units) Prerequisite: MGE 261**

Static force and moment analysis; analytical and graphical methods – Superposition principle – Dynamic analysis - Dynamic of rigid bodies - Center of percussion –Shaking forces and moments – Vibration analysis – Critical speed and resonance –

Longitudinal and transverse vibrations – Tensional vibrations balancing: static and dynamic balancing – Balancing machines – Balancing of rotating masses -Reciprocating engines – Flywheel - Dynamic of analysis of cams – Governors.

**MPE 463 Mechanical Vibration (2 Units) Prerequisite: MGE 221**

Introduction to the concept - Simple harmonic motion - Combination and split up of simple harmonic motions - Un-damping free vibration of single degree freedom - Systems: Natural frequency of vibration - Energy method - Simple and compound pendulum – Energy - Force and torque methods - Equivalent systems - Damping free vibration of single degree freedom system: viscous damping - under critical and over damping system - Equivalent dampers - Coulomb damping - Equivalent damping - Coefficient - Logarithmic decrement - Forced vibration of single degree freedom system - Sources of excitation, impresses harmonic force - Impressed force due to unbalance or acceleration excitation - Motion excitation - Magnification factor - Frequency response - Two degree freedom system - Natural frequency: classical method – Models - Multi degree freedom systems: Holzers methods – Reyleghs method – Stodoas method.

**MPE 434 Hydraulic Machines (3 Units) Prerequisite: MPE 432**

Introduction – Velocity triangles – Principles of momentum - Energy equation – Turbo machine theory - Euler theory – Dimensional analysis – Efficiency laws – Specific speed – Specific diameter – Pressure and volume coefficients – Cascade mechanics – Analysis of Force and coefficient of lift and drag resistance – Cascade performance – Pressure and flow rate diagram for straight cascade – Pressure distributor – Centrifugal pumps ( performance – maintenance – troubles ) – Cavitations theorem – Axial pumps – Pump selection – Hydraulic turbines – Pelton wheel – Francis Turbine – Kaplan turbine – Axial compressors – Volumetric machines – Performance of reciprocating and rotary pumps.

**MPE 445 Gas Dynamics (2 Units) Prerequisite: MPE432 & MPE442**

Principals – Continuity and Bernoulli equations for compressible flow – Sonic velocity and mach number – Waves spreading – Empirical relations between pressure, temperature, density, and mach number – Flow density – The difference between subsonic and supersonic flow – The effect of increase in entropy – Damping energy – Accelerating and decelerating velocity in flow in pipes – Shock wave – Vertical shock wave equations derivation – Curve of multi weak shock waves – Shock wave spreading velocity – Two dimensional gas dynamic problems – Frictional equations derivation – Subsonic flow – Expansion relations for supersonic flow.

**MPE 453 Internal Combustion Engines (3 Units) Prerequisite: MGE 343**

Basic engine types and their operation - Testing and dynameters, performance factors - Pressure measurement - Combustion in SI-engine - Combustion in CI-engine – Fuels - Octane and Cetane ratings - Knock and detonation the engine variables - Fuel metering in SI-engine - Elementary carburator, ignition systems - Fuel metering in CI engines - Wankel engine.

**MPE 465 Machine Design II (2 Units) Prerequisite: MGE 364**

Design analysis of shaft coupling and clutches - Introduction to friction and wear theory – Bearings - Rolling bearings - Selection and bearing calculations - Examples of correct design of bearing systems - Journal bearings; bearings with fluid and mixed friction - Construction and calculations of journal bearings - Gears: Spur gears - Geometry of bearings determinations of teeth numbers and load - Design analysis of gear trains - Planetary gear trains – Constructional arrangements - bevel worm and helical gears – Belt – Rope and chain drive - Computer methods application for optimum design of machine elements.

**MPE 475 Maintenance Engineering (3 Units) Prerequisite: MGE 315**

Introduction: Definition and objectives – Statistical concepts – Mathematics of failure: Reliability concepts – Fitting distribution to failure data – Maintenance management: investment decisions – Maintenance profit impact – Maintenance structure: Preventive – time based – condition based – corrective – design out – Data analysis: Renewal – repairable systems – Laplace trend test – analysis methodology – Optimizing maintenance strategies: Replace-ment/overhaul age – Inspection frequencies – Capital replacement – Simulation – Reliability – Centered Maintenance (RCM) – Maintenance systems: Components – structure – computer methods – Maintenance Practice: Systems approach – Management approach – Modeling.

**MPE 533 Computational Methods in Mech, Eng (2 Units) Prerequisite: MPE 432 & ME 442**

Introduction to computational fluid dynamics – Methods of engineering calculating and evaluating – Numerical representation for fluid and heat flow equations using finite difference and finite volume methods – Principals of accuracy, converging and stability of numerical solutions – Application in fluid flow problems and thermal processes using numerical analysis computer program packages and computational fluid dynamics.

**MPE 546 Renewable Energy (3 Units) Prerequisite: ---**

Introduction - The Origin of Renewable Energy Flows - The Individual Energy Sources - The Energy Conversion Processes - Energy Transmission and Storage - Energy

Supply Systems - Socio-economic assessment of Energy supply systems - Technologies for Renewable Energy.

**MPE 551 Refrigeration and Air Conditioning (3 Units) Prerequisite: MPE 442**

Introduction – Gas Refrigeration cycles – Vapour compression cycles – Working fluids - Refrigerants – Multi pressure cycles – Compressors – Condensers – Expansion devices – Evaporators – Complete vapour compression refrigeration system – Moist air properties – Psychometric and air conditioning processes – Vapour absorption cycle – Vapor suction cycles – Applications in air conditioning – Designing considerations – Load estimation – Air transport and distribution – Control devices – Non-conventional cooling systems.

**MPE 555 Power Plant Engineering (2 Units) Prerequisite: MGE315 & MPE442**

Energy sources and utilization – The thermodynamic analysis of Rankine cycle – Steam generators – The condensate feed water systems – The circulating water systems - Cooling systems – Gas turbines and combined cycles – The nuclear power stations – Power plant economics.

**MPE 591 Summer Training (2 Units) Prerequisite: ---**

Presentation and discussion of technical paper reports. Methods for improving oral communication. Discussion in a capacity which ensures that the student applies his engineering knowledge and acquires experience in his field of study of undergraduate of Mechanical Power Engineering at Sirte University. The student is required to communicate, clearly and concisely, details and gained experience both orally and in writing. The student is evaluated based on his abilities to perform, demonstrate technical competence, work efficiently, focused to quality oriented, and committed to personal professional development.

**MPE 558 Turbo Machines (3 Units) Prerequisite: MPE442 & ME445**

Introduction in Turbo machines - Turbo machines types – Thermodynamic cycles of turbo machines – Steam flow in turbo machine nozzles – Steam flow throw impulse and reaction turbine blades – Bleeding and reheat systems in steam turbines – Performance parameters at variable loads - Methods of steam turbine control – Velocity regulation in steam turbines – Thermodynamic cycles of steam turbines - Gas turbines types – Thermodynamic cycles of gas turbines - Elements of gas turbines used in power stations and jet engines – Gas turbine performance – Air compressors – Design and methods of cooling gas turbine blades – Inlet and outlet ports of gas turbines used in airplanes - Diffusers design – Combustion chambers in gas turbines – Combined cycles.

**MPE 492 Graduation Project I (2 Units) Prerequisite: ---**

The first in a two-part course sequence applying an integrated system design approach on a team-based project, open-ended problem with realistic constraints. Team effort and both oral and written presentations are a part of the experience. Important topics are presented in the lectures including the design process, design tools, engineering communication, engineering ethics, and intellectual property.

**MPE 554 Water Desalination (2 Units) Prerequisite: ---**

Potable water resources and need for desalination, Fundamentals of desalination, Overview and classification of desalination techniques, Single and multiple effect evaporation, Vapor compression, Single and Multi-stage flash distillation, Reverse Osmosis, Hybrid processes, Dual Purpose Power and Desalination plants, Desalination powered by renewable energy sources, Economic analysis, Brine discharge management.

**MPE 593 Graduation Project II (2 Units) Prerequisite: MPE 599 (I)**

Continuation and completion of project started in ME. Oral presentation and submission of final written report of the design project are essential requirements for the completion of the course.

## المحتوي العلمي للمقررات الدراسية الاختيارية بشعبة هندسة ميكانيكا القوى
## Description of Courses Content for Mechanic Power Engineering Section

**MPE 580 Introduction to Railway Engineering (3 Units) Prerequisite: ---**

Introduction and History of Railway Design; Comparisons to Other Transport Systems; Economy, Requirements, Resources and Strategy; Demand Tariffs and Capacity; Rolling Stock; Railway Operations; Modern Railways Designs; Gauge Selection; Railway Traction and Loading; Route Design; Platforms, Bridges, Crossings, Canopies and Depots; Sand Blankets, Drains, Masonry, Fasteners, Concrete, Bolts and Welds; Sleeper, Ballast and Sub-Beds; Wheel-Rail Interface; Curves and Gradients; Track Loads; Wheel Design; Mechanical Problems: Life-time, Failures, Thermal, Stresses, Strains, Elasticity, Wear and Creep Issues. Track Defects.

**MPE 580 AIRCRAFT ENGINE DESIGN (3 Units) Prerequisite: ---**

Turbine aviation engines: scope of using, design schemas, overview of units, aerothermodynamics calculations techniques. Short overview of basic design problems, overview basic responsibilities of control, diagnostic and monitoring unit. Guided, individual or group project of aircraft engines or its elements, the maintenance and repair procedures of both Piston and Gas Turbine Engines and their procedures followed for overhaul of aero engines.

**MPE 580 Solar Thermal Energy (3 Units) Prerequisite: ---**

Introductory aspects of non-renewable and renewable energy sources fundamentals of thermal radiation – resource assessment – solar radiation concepts – solar-earth geometry – models to predict global and daily and hourly irradiation. Solar collection theory and technologies (non-concentrating): heat transfer in solar collectors – basic modelling aspects – steady and dynamic analysis – performance parameters. Solar concentration systems and receivers: overview and introduction to concentration optics – concentration ratio and thermodynamic maximum – linear concentration: trough and linear Fresnel – point concentration: dish and tower (central receiver system). Thermal storage: need for thermal storage – methods – simple models. Solar power generation systems: overview and types of systems – components and sub systems – aspects of design and performance prediction. Solar cooling: solar liquid absorption and solar solid sorption technologies.

**MPE 580 Fundamentals of Combustion (3 Units) Prerequisite: ---**

Combustion and thermochemistry – fuels – chemical kinetics and mechanisms – reacting flows – modelling of reacting flows – premixed flames – detonation and explosion – introduction to turbulence – turbulent premixed combustion – non-premixed combustion – turbulent non premixed combustion – spray combustion – combustion instability.

# المحتوي العلمي للمقررات الدراسية الخاصة بشعبة هندسة ميكانيكا الطيران
# Description of Courses Content for Mechanic Aeronautic Engineering Section

**MAE 450 Fundamental of Aerodynamics (3 Units) Prerequisite: GS222& MGE231**

Dynamics of atmosphere, structural and geometric configuration of aircraft components, airfoil and wing geometry, general aerodynamic characteristics of airfoils and wings, aerodynamic forces and moments, high speed flight, viscous effects. **Performance**: General meaning of aircraft performance, elements of aircraft performance, power effects, operating limitations, **Flight mechanics:** General meaning of equilibrium, general meaning of stability, requirements to achieve equilibrium effect of C.G. position, types of controls of aircraft, lateral and directional control of aircraft. **Propulsion:** Aircraft engine types, aircraft engine components, **Structures:** Familiarization with the main components of the airplane, and terminology, control surfaces, basic flight instruments, structural configuration, basic materials and manufacturing processes.

**MAE 460 Theory of Flight (2 Units) Prerequisite: MGE224 &MGE261**

Flight of lighter than and heavier than air, lift, drag, and moment of flight vehicles, general equations of motions of airplanes in free space, different coordinate systems, atmospheric flight, thrust and power required for propeller driven and turbojet driven aircraft systems, level performance, climb, cruise performance, take-off and landing, manoeuvre performance, turning flight, thrust and lift boundaries of aircraft. Longitudinal, lateral and directional static stability, handling qualities and characteristics of light aircraft, fixed wing aircraft in subsonic flight, manoeuvring characteristics of perturbed motion.

**MPE 444 Heat Transfer II (2 Units) Prerequisite: MGE343**

Multidimensional conduction heat transfer - One-dimensional unsteady conduction heat transfer – Forced convection - External and internal flows - Momentum and thermal boundary layers analysis (momentum integral method) – Natural convection - Boiling heat transfer - Nucleate boiling - Film boiling – Condensation heat transfer - Condensation, turbulent and laminar film condensation on surfaces – Heat exchanger and its types – Logarithmic mean temperature difference calculation – Fouling resistance - Heat exchanger design - Thermal insulation – Types - Properties and selection methods of insulating materials.

**MAE 463 Aircraft Vibration (2 Units) Prerequisite: MGE224**

Basic concepts of vibration and applications-Free vibration of single degree of freedom systems; damped, vibrations; types of damping; forced vibrations of single-degree of freedom system. Two degrees of freedom systems; normal modes of vibration; coupled co-ordinate; Multi-degree of freedom system; flexibility matrix and stiffness matrix; Eigen values and Eigenvectors; Lagrange's equation with application Torsional and bending vibration of continuous systems; Vibration measuring instruments; aircraft ground resonance test.

**MAE 458 Hydraulic Turbomachine (3 Units) Prerequisite: MGE231&MGE341**

Introduction in Turbo machines - Turbo machines types – Thermodynamic cycles of turbo machines – Steam flow in turbo machine nozzles – Steam flow throw impulse and reaction turbine blades – Bleeding and reheat systems in steam turbines – Performance parameters at variable loads - Methods of steam turbine control – Velocity regulation in steam turbines – Thermodynamic cycles of steam turbines - Gas turbines types – Thermodynamic cycles of gas turbines - Elements of gas turbines used in power stations and jet engines – Gas turbine performance – Air compressors – Design and methods of cooling gas turbine blades – Inlet and outlet ports of gas turbines used in airplanes - Diffusers design – Combustion chambers in gas turbines – Combined cycles.

**MAE 442 Thermodynamics II (2 Units) Prerequisite: MGE341**

Mixture: General consideration - Dalton's - Amagat model of a mixture of gas and a vapor - Psychometric chart - Combustion: Fuels - Combustion process - Enthalpy of formation - Adiabatic flame temperature - Heat of reaction - Bomb and Juncker's calorimeters - Thermodynamics cycles: Carnot - Rankine – Reheat – Otto – Diesel – Dual – Brayton – Vapour - Compression refrigeration - Ammonia-absorption refrigeration cycles - Thermodynamics relations: Maxwell relations - Relations involving, Enthalpy, Internal energy and Entropy - Thermodynamics tables.

**MPE 442L Thermal-Fluid Lab (1 Units) Prerequisite: MGE341**

Performance test on a 4-stroke engine 2. Valve timing of a 4 – stroke engine and port timing of a 2-stroke engine 3. Determination of effectiveness of a parallel flow heat exchanger 4. Determination of effectiveness of a counter flow heat exchanger 5. Determination of the viscosity coefficient of a given liquid 6. COP test on a vapour compression refrigeration test rig 7. COP test on a vapour compression air-conditioning test rig 8. Study of a Gas Turbine Engine. 9. Determination of Conductive Heat Transfer Coefficient. 10. Determination of Thermal Resistance of a Composite wall.

**MAE 453 Aircraft Engines & Jet Propulsion (3 Units) Prerequisite: MAE450 & MAE442**

Study of basic principles of propulsion systems with emphasis on jets and fan systems. Introduction to air breathing propulsion systems, thermodynamic cycles of gas turbine engines and their performances, the turbojet engine components and functions, engine non-rotating component aerodynamics and performance, **Compressor:** Axial and centrifugal compressor's velocity diagrams, Compressor losses, Compressor stall and surge. Comparison between axial and centrifugal compressor. **Turbine**: Axial and radial turbines, Axial turbine velocity diagrams and losses. Turbine blade cooling systems. **Jet Engine Construction:** Construction aspects of jet engine including turbine and compressor blade design and construction. **Matching:** Conservation of energy and mass through the engine components. Compressor map, matching procedure. Engine transient operation engine: starting problems, engine acceleration and deceleration.

**MAE 483 Fundamentals of Aircraft Electricity & Instruments (3 Units) Prerequisite: MGE330 & MGE385**

Study The Nature of Electricity, Theory and Principle, Units of Electrical Measurement, Sources of Electricity , Chemical Action And Magnetism , Current Electricity and OHM'S Law, Circuit Elements , Electric Power , DC and AC. Current In Series and Parallel Circuits , Primary & Secondary Cells Batteries , Lead Acid and Nickel Cadmium Batteries , AC Voltage and Current , Resistance , Inductance and Capacitor in AC Circuits , Electron Control Devices and the Use of Electrical Measuring Instruments.

**MAE 466 Aircraft Flight Dynamics (2 Units) Prerequisite: MAE 450**

Aircraft static longitudinal stability. Neutral point. Longitudinal control. Center of gravity limits. Hinge moments. Stick free stability. Stick force. Speed stability. Directional static stability. Directional control. Roll static stability. Roll control. Three-dimensional rigid body dynamics, aircraft equations of motion, unsteady equations of motion. Small disturbance theory. Stability derivatives. Linear zed equations of motion. Dynamic stability. Reduced-order models. Longitudinal and lateral stability modes. Flying qualities. Introduction to state feedback and pole placement.

**MAE 436 Incompressible Flow (2 Units) Prerequisite: MGE231&MAE442**

Two-Dimensional Inviscid Fluid Flow, Stream Function and Velocity Potential, Superposition of Elementary Flows, Source Panel Methods, Thin airfoil theory, Vortex Panel Methods, Finite Wings. Vortex Lattice Method, Incompressible Boundary Layer, Aerodynamic Design.

**MAE 433 Computational Methods (2 Units) Prerequisite: MAE450 & MAE442**

Introduction to computational fluid dynamics – Methods of engineering calculating and evaluating – Numerical representation for fluid and heat flow equations using finite difference and finite volume methods – Principals of accuracy, converging and stability of numerical solutions – Application in fluid flow problems and thermal processes using numerical analysis computer program packages and computational fluid dynamics.

**MAE 427 Aircraft Construction Materials (2 Units) Prerequisite: MGE225**

Properties and applications of aircraft materials, forming methods, and manufacturing processes. Ethics and social responsibility for engineers. This course covers the nomenclature, properties and processing of engineering materials used in airframes, landing gear, and gas turbine engines. Materials examined will include structural aluminium alloys, titanium alloys, stainless steels, nickel based super alloys, high strength heat treated steels, fibre composites, honeycomb sandwich panels and layered composites, such as GLARE (Glass Laminate Aluminium Reinforced Epoxy). Manufacturing processes including chemical milling, forging, extrusion and composite lay-up are also discussed. The role of non-destructive inspection and airworthiness are presented along with the effects of long service exposure on mechanical properties of structural alloys

**MAE 537 Aircraft Structure I (3 Units) Prerequisite: MAE427**

Gives Generic Study about Aircraft Structural Materials and Covers the Properties of Metals and Non-Metallic Structural Materials. Also Deals with. Principles of Stressed Skin Construction: Materials used, Loads, Fabrication & Structural idealization. Open and Closed thin Walled tubes: Bending, Shear and Torsion, Strain and Displacement, Booms, Applications. Multi-cell tubes: Bending, Torsion & Shear, Shear Variation, Effect of taper, Deflection, Applications. Energy methods: Strain and Complementary energy, Total Potential and its Stationary Values, Applications. Bending of thin plates which involves both exact and energy method solutions, combined bending and in–plane loading, effect of pre-loading curvature, structural instability: Euler buckling of perfect columns; inelastic buckling; loading of single and multi-cell thin walled tubes and torsion boxes, deflection phenomena Flight of lighter than and heavier than air, lift, drag, and moment of flight vehicles, general equations of motions of airplanes in free space, different coordinate systems, atmospheric flight, thrust and power required for propeller driven and turbojet driven aircraft systems, level performance, climb, cruise performance, take-off and landing, manoeuvre performance, turning flight, thrust and lift boundaries of aircraft. Longitudinal, lateral and directional static stability, handling qualities and characteristics of light aircraft, fixed wing aircraft in subsonic flight, manoeuvring characteristics of perturbed motion.

**MAE 567 Aircraft Performance (2 Units) Prerequisite: MAE460**

The fundamentals of conventional aircraft flight. **Elements and functions of aircraft basic configuration:** forces and moments acting on an aircraft, aerodynamic coefficients, standard atmosphere. **Performance:** equations of motion, horizontal flight, climb performance, take-off performance, gliding descent and landing performance, range and endurance, flight envelope, V-n diagram. Longitudinal static stability: aerodynamic center, criterion for longitudinal static stability, static margin, unstable aircraft

**MAE 568 Aircraft Component Design & Assembly (2 Units) Prerequisite: MAE483**

Stresses of loading aircraft, fatigue, rivet and joint stress variation, design operations, design of basic machine elements; shafts, hays, belts, etc., V-n diagram, structural layout drawing, wing design, fuselage, tail, take-off-landing system design

**MAE 584 Aircraft Stability and Control (2 Units) Prerequisite: MAE483**

Systematic account of Aircraft Stability and Control system elements and configuration. This includes the Static Longitudinal ,Directional and Lateral stability with respect to the aircraft axis systems. Effect of various wings design and secondary control surfaces. The Aircraft system includes; A/C System in general, Hydraulic system, Pneumatic system ,Flight control system, Landing gears system, fuel system, Cockpit pressurization & air conditioning system, Speed brake and thrust reversal, anti-icing system, electrical system ,flight instruments, lifesaving equipment.

**MAE 513 Avionics (2 Units) Prerequisite: MGE211**

An introduction to modern avionic systems. Topics include: Terrestrial and Satellite Navigation Aids, Landing Systems, Surveillance Systems, Air-Ground and On board Communications, and Autopilots. Electronic devices which facilitate flying such as radars ILS (Instrument Landing System) ADF (Automatic Direction Finder) etc were specifically invented by the Avionic/Aircraft Instrument Engineer. The Avionic/Aircraft Instrument Engineer will have to ensure that the instrument fitted on an aircraft will function satisfactorily together with a high degree of reliability.

**MAE 575 Aircraft System & Maintenance (3 Units) Prerequisite: MGE315**

Preliminary design project of a complete propulsion system, including the airframe. Technical written reports and oral presentations. LEC turbines used in airplanes - Diffusers design – Combustion chambers in gas turbines – Combined cycles.

**MAE 538 Aerospace Structures II (2 Units) Prerequisite: MAE537**

An introduction to the Theory of Elasticity. Structural instability of columns and thin plates. Analysis methods (Virtual work and energy and matrix methods including FEM) for stress and deflection calculations in determinant and indeterminate structures. Thin plate theory. Composite materials analysis and design. Light aircraft design and build project.

**MAE 538L Aerospace Structures Lab (1 Units) Prerequisite: MAE537**

Hardness tests: Brinell hardness, Vickers hardness, Rockwell hardness – Buckling of struts –Experiments on thin-walled pressure vessel – Unsymmetrical bending and shear center measurements, measurement of strain using strain gauges, Shear force in a beam, Deflection of beams and cantilevers, Continuous and indeterminate beams.

## المحتوي العلمي للمقررات الدراسية الاختيارية بشعبة هندسة ميكانيكا الطيران
## Description of Courses Content for Mechanic Aeronautic Engineering Section

**MAE 542 Helicopter Theory (3 Units) Prerequisite: ---**

Introduction: Helicopters in general, critical parts of helicopters, types of helicopters. Rotor in vertical flight (momentum theory). Rotor in vertical flight (blade element theory). Mechanisms of rotor. Forward Flight: Momentum theory, blade element theory. Performance and Trim-Stability: Helicopter design, blade section design, blade tip shapes, rear fuselage upsweep, second harmonic control.

**MAE 542 Environmental Pollution (3 Units) Prerequisite: ---**

Pollution - Types of pollution – a brief study of the various types of pollution - Air pollution - Sources and effects of major air pollutants – Gases - Oxides of carbon, nitrogen and sulphur – Hydrocarbons – Particulates -Control of air pollution - Different methods - Water pollution - Sources and effects of major pollutants - Inorganic pollutants- heavy metals cadmium , lead, mercury - Ammonia, Fertilizers and Sediments (silt) - Organic pollutants – Detergents, pesticides, food waste, - Radioactive materials - Thermal pollutants - Control of water pollution - General methods.

**MAE 542 Air-Breathing Propulsion (3 Units) Prerequisite: ---**

Pollution - Introduction to combustion and flames – introduction to air breathing propulsion systems – engine thrust and performance parameters – aircraft engine types – ideal and real gas turbine cycle analysis – performance measures – engine-aircraft matching – aerothermodynamics of inlets, nozzles, combustion chambers and after burners – basics of turbomachinery – compressor and turbine blade flow path analysis (axial and centrifugal types) – engine component matching and off-design analysis – ram jets – hypersonic air-breathing engines.

**MAE 542 Finite Element Method (3 Units) Prerequisite: ---**

Introduction – finite element formulation from differential equation – finite element formulation based on stationarity of a functional – one-dimensional finite element analysis; shape functions, types of elements, applications – two-dimensional finite element analysis – numerical integration– applications to structural mechanics and fluid flow.

**MME 486 Physical Metallurgy I (3 Units) Prerequisite: MGE 225**

Crystal structure, imperfections, voids and stacking sequence. Plastic deformation and annealing, recovery, recentralization and grain growth. Solid solution, Hume rothery rules. Binary phase diagrams, miscibility gap, eutectic, eutectoid, peritectic phase diagram. Fe-C Systems, structure of steels, cast iron, heat treatments, grading and classification of steels. Solidification of metals, thermodynamics, kinetics and casting defects.

**MME 422 Strength of Materials II (2 Units) Prerequisite: MGE 221**

Complex stress- strain relationship - Deflection of beams - Moment curvature relation - Boundary conditions - Double integration method - Singularity function and moment area method - Strain energy for various loadings and Castiliano's theorem - Buckling of columns - Euler's and Rankine Gordon's formula - Theory of thick cylinders - Springs curved bars - Failure elastic theories - Introduction to plastic stress and Strain relationship - Introduction to mechanics of composite.

**MME 421 Engineering Alloys (3 Units) Prerequisite: MME 486**

Classification of engineering alloys and its application according to its uses, steels, cast-irons, effect of composition and heat treatment, tool steels, alloys for wear resistance, materials of high coefficient of friction, oxidation resistance alloys and materials which used elevated temperature, nickel alloys, heat resistant alloys, stainless steels, copper alloys, aluminium alloys, materials of special electric Properties, magnetic materials.

**MME 440 Metallurgical Thermodynamics (3 Units) Prerequisite: MGE 341**

The Behavior of Gases; gas mixtures of ideal gases, the thermodynamic treatment of imperfect gases, deviation from ideality and equations of state, the van der walls gas. Reactions involving Gases; reaction equilibrium in a gas mixture and the equilibrium constant, the effects of temperature and pressure on the equilibrium constant, reaction equilibrium in the system $SO_2(g)$-$SO_3(g)$-$O_2(g)$, equilibrium in $H_2O$-$H_2$ and $CO_2$-CO mixtures, gaseous reaction equilibrium and fugacity. Reactions involving Pure Condensed Phases and a Gaseous Phase; free energy variation with temperature, Ellingham diagrams, the effect of phase diagram, the oxides of carbon, graphical representation of equilibrium in the system metal-oxygen-carbon. The Behavior of Solutions; Raoult's law and Henry's law, the activity of a component in solution, the Gibbs-Durham equation, the free energy of solution, the properties of raoultain ideal solutions, no ideal solutions, regular solutions. Free Energy-Composition and Phase Diagrams of Binary Systems. Reaction Equilibrium in Systems Containing Components in Condensed Solutions.

**MME 477 Production Engineering II (3 Units) Prerequisite: MGE 376**

Metal casting; moulding materials, core making, various casting processes. Welding processes and equipment's, types of welds. Lathe machine, lathe machine components, cutting speed. Forging processes and defects. Rolling of metals and defects. Extrusion processes. Drawing of rods, wires and tubes.

**MME 420 Finite Element Methods I (3 Units) Prerequisite: MGE231&MGE341**

Introduction: basic concept of the finite element method, comparison with finite difference method; Variation methods: calculus of variation, the Rayleigh-Ritz and Galerkin methods; Finite Element analysis of 1-D problems: formulation by different approaches (direct, potential energy and Galerkin); Derivation of elemental equations and their assembly, solution and its post-processing. Applications in heat transfer, fluid mechanics and solid mechanics. Bending of beams, analysis of truss and frame. Finite element analysis of 2-D problems: finite element modelling of single variable problems, triangular and rectangular elements; Applications in heat transfer, fluid mechanics and solid mechanics; Numerical considerations: numerical integration, error analysis, mesh refinement. Plane stress and plane strain problems; Bending of plates; Eigen value and time dependent problems; Discussion about preprocessors, post processors and finite element packages.

**MME 487 Physical Metallurgy II (3 Units) Prerequisite: MME 486**

Diffusion in substitutional solid solutions and interstitial solid solutions, theories of phase transformation, phase transformation of steel on heating, eutectoid transformation, Binaite transformation, transformation associated with steel tempering, heat treatment of metals and alloys, chemical thermal treatment of metals and alloys, hardenability of steels.

**MME 428 Mechanical Behaviour of Materials (3 Units) Prerequisite: MGE 225**

Concepts of Stress and types of Stresses, Concepts of Strain and types of Strain. Stress and Strain Relationships for Elastic Behaviour; Description of stress at a point, state of stress in two dimensions, state of stress in three dimensions, Description of strain at a point, Hydrostatic component of stress, Elastic Stress – Strain relations, Calculation of Stresses from Elastic Strains, Strain Energy, Anisotropy of Elastic behaviour, Stress Concentration. Dislocation Theory. Mechanism of plastic deformation. Strengthening mechanism. Creep mechanism. Fracture and fracture toughness of materials. Fatigue mechanism.

**MME 488 Extractive Metallurgy (3 Units) Prerequisite: MGE225&MME440**

Introduction of extractive metallurgy, Mineral Dressing (Processing), Concentration (Separation), Types of Concentration Processes. Calcination, Roasting, Agglomeration. Pyrometallurgy, Hydrometallurgy, Electrometallurgy. Application of extractive procedures; Pyrometallurgical extraction of iron, Hydrometallurgical extraction of copper.

**MME 429 Ceramic Materials (3 Units) Prerequisite: MME 428**

Introduction: ceramic materials in relation to metals & polymers: (interatomic spacing & bonding, crystal structures, imperfections. Glass–structure, composition transformation range, crystallization. Ceramic microstructures and mechanical, thermal, electrical, optical and nuclear properties. Ceramics Powder Processing, shaping techniques, Drying and Sintering, methods of glass shaping, Applications of ceramics. Cement, their manufacture and hydration behavior, Refractories, their types, manufacturing and applications. Engineering ceramics; their classes, manufacturing and applications.

**MME 489 Metallography Laboratory (3 Units) Prerequisite: MME 486**

Specimen preparation for microscopical examination of pure metals and alloys, effect of heat treatment on carbon steel, hardenability of alloys. Alloy steels, tool steels, cast iron, nonferrous metals and alloys.

**MME 470 Metal Cutting and Machining Technology (3 Units) Prerequisite: MGE 376**

Principles of Metal Cutting: Tool Materials, Tool Geometry (ASA, ORS Systems), mechanisms of chip formation, Cutting forces, cutting Temperatures, Tool wear and Tool life, Surface finish and machinability, optimization of cutting parameters, Tool path generation and machining principles, Setting and machining operations on metal cutting machine; lathe, milling, shaping, slotting, planning, drilling, boring, broaching, grinding (cylindrical, surface, centreless), thread rolling and gear cutting machines; Tooling: jigs and fixtures, principles of location and clamping; Batch production: Machining on capstan and turret lathes; Mass production: Machining on single/multi spindle automats, Finishing: microfinishing operations like honing, lapping, superfinishing.

**MME 571 Manufacturing Process Laboratory (1 Units) Prerequisite: MME 477**

Casting: sand preparation, sand testing: specimen preparation, permeability, clay content, grain fineness number, green compression strength, green shear strength, dry strength, hardness. Characterization of materials - solids and fluids. Introduction to primary technology processes involving forging and casting, preparation of foundry sand and molds, Experiments on properties of post casting, fettling, cleaning, deburring, polishing and painting operations. Surface preparation and etching techniques, heat treatment and metallographic studies. Laboratory experiments in fabrication processes : Spot, MIG, ARC and Gas Welding, Testing of Joints.

**MME 520 Polymeric Materials (3 Units) Prerequisite: MGE 225**

Introduction, definitions, classification, bonding, general physical properties. Viscoelasticity models. Design methodology. Melt Rheology (I) & (II), properties of polymer melts & types of flow. Shaping methods of polymers. Fibre & elastomer technologies. Reinforcements & polymeric composites. Processing – property interactions.

**MME 510 Non-Destructive Testing (3 Units) Prerequisite: ---**

Introduction; types of defects in metal forming methods, their effect on mech. Properties. Visual aids: Boroscopes, Toboscope and their use in testing. Liquid penetrant methods. Magnetic Particle methods. X-ray radiography. Ultrasonic Technique. Gamma rays radiography. Thickness measurements. Eddy current. methods.

**MME 518 Fracture Mech.& Failure Analysis (3 Units) Prerequisite: MME 428**

Ductile and brittle fractures, Catastrophic fractures Griffth theory of brittle fracture, Ductile to brittle transition temperature, stress concentration factor, modes of crack propagation (mode I, II, and III), Linear elastic fracture mechanics, Stress intensity factor, Plane strain and plane stress fracture toughness, Plastic zone size estimation, Determination of fracture toughness ASTM – E399 test. Correlation of impact energy to fracture toughness. Factors affecting fracture toughness. Ways to improve fracture toughness. Definition of failure, Fundamental sources of failure, Procedure for conducting failure analysis, overload failure, elevated temperature failure, corrosion fatigue.

**MME 528 Composite Materials (3 Units) Prerequisite: MGE 225**

Introduction, purpose of uses and application of composite materials, composite materials reinforced by fibres, composite materials reinforced by dispersed fine particles, composite materials reinforced by particles, multilayers composite materials, mechanical and physical properties of composite materials, types of composite materials, composite materials reinforced by metallic textiles, manufacture methods of composite materials reinforced by metallic textiles and its application, composite materials reinforced by ceramic textiles, application of ceramic textiles composite materials in: aerospace - cutting tools – electric components, composite materials reinforced by polymer textiles: manufacture methods, application .

**MME 570 Welding Engineering (3 Units) Prerequisite: MME 487**

Introduction to welding: General survey and classification of welding processes, Safety and hazards in welding, Power sources for arc welding. Welding consumables: fluxes, gases and filler materials. Electrodes: types, coatings and its functions, selection of electrodes, designation of electrodes as per Indian standard. Metal transfer and its importance in welding, various forces acting on a molten droplet. Gas welding processes and equipment: Shielded metal arc welding, Submerged arc welding Gas tungsten arc welding, Gas metal arc welding, & its variants, Electro slag welding and Electro gas welding, Plasma arc welding, Resistance welding, & its variants. Modern welding processes: Electron beam welding, Ultrasonic welding, Laser welding, Explosive welding, Friction stir welding, Soldering and brazing. Weldability of commonly used materials: Carbon steels, Stainless steels, Cast iron, Cu and its alloys, Al and alloys. Defects in welds, Non-destructive testing of welds.

## المحتوي العلمي للمقررات الدراسية الاختيارية بشعبة هندسة ميكانيكا علم المواد والإنتاج
## Description of Courses Content for Mechanic Materials Science & Production Engineering Section

**MME 580 Nano-Materials (3 Units) Prerequisite: MGE 225**

Introduction, Fundamentals of nanoscience and Nanotechnology, types of nanomaterials. Synthesis of nano-crystalline powders. Preparation of bulk nano-crystalline materials. Characterization of nano-systems. Nanomaterials Applications: Nanotubes, nanowires, and nanodevices-introduction – Functional Nanostructures.

**MME 580 Solar Energy (3 Units) Prerequisite: ---**

Solar Energy: Basic properties of solar energy. Applications of solar energy. Transformation of solar energy. Solar heat collectors. Solar photovoltaic collectors. Application of solar collectors examples. Solar power plant. Economics of solar collectors. Trends in solar energy utilization.

**MME 580 Light Alloys (3 Units) Prerequisite: MME 487**

The light metals: introduction, production of aluminium, magnesium and titanium. Physical metallurgy of aluminium alloys, wrought aluminium alloys, cast aluminium alloys, Magnesium alloys: introduction, melting and casting, wrought magnesium alloys, application of magnesium alloys. Titanium alloys: introduction, alpha alloy, alpha/bite alloys, bite alloys, castings, and applications.