Ferdowsi University of Mashhad
Engineering Faculty
Department of Mechanical Engineering

Bachelor of Science
Aerospace Engineering Course Description

Course ID Course Title

Course description and outlines

Prerequisites

Credit hours

Course Type

Course Length

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274 Physics I

Use of fundamental principles to solve quantitative problems. Motion, forces, conservation principles, structure of matter. Applications to mechanical systems.

Prerequisite: none

4.000 Credit hours

Course Type: Practical-Theoretical

Course Length: 51 hours

23105024 General Math I

Calculus involving transcendental functions; Complex numbers; Functions; Inverse trigonometric functions, hyperbolic functions; limits and relevant theorems; Continuity; derivatives and relevant theorems; applications of derivative; Integrals, Techniques of integration; applications of integrations; infinite sequences and series; Taylor and McLaurin series.

Prerequisite: none

3.000 Credit hours

Course Type: Theoretical

Course Length: 51 hours

23131024 Industrial Drawing I

Engineering drawing principles and techniques: orthographic projection, sketching, sections, auxiliary views, dimensioning and conventional practices, Three and Six views.Oblique and perspective projections Axonometric and oblique drawings. ISO recommendation and methods of obtaining views.

Prerequisite: None.
2.000 Credit hours
Course Type: Graphics
Course Length: 68 Hours

273 Physics II

Electric Charge, Electric Fields, Gauss' Law, Electric Potential, Capacitance, Current and Resistance, Circuits, Magnetic Fields, Magnetic Fields Due to Currents, Induction and Inductance, Electromagnetic Oscillations and Alternating Current, Maxwell's Equations; Magnetism of Matter, Electromagnetic Waves.

Prerequisite: 274 Physics I
4.000 Credit hours
Course Type: Theoretical
Course Length: 51 hours

23131262 Introduction to Aerospace Engineering

This course provides us the basic concepts in various aspects and subjects of Aerospace engineering. Reference: John David Anderson, Introduction to flight

Prerequisite: 23105024 General Math I, 274 Physics I
2.000 Credit hours
Course Type: Theoretical
Course Length: 34 hours

22113184 Airplane Model Workshop

Prerequisite: none
1.000 Credit hours
Course Type: Practical
Course Length: 34 hours

22205012 Differential Equations

Nature of differential equations and their solution, ellipse and orthogonal lines, first-order linear differential equations, homogeneous equations, second order linear equations, homogeneous equations with constant multiplies, un-defined multiplies method, parameter transformation method, application of second order

equations in physics, solving differential equations with series, Bessel function and Gama function, Laplace conversion and its applications in differential equations solution.

Prerequisite: 23105024 General Math I
3.000 Credit hours
Course Type: Theoretical
Course Length: 51 hours

23130010 General Math II

Derivative as linear map. Differential/integral calculus of functions of several variables, including change of coordinates using Jacobians. Line/surface integrals. Gauss, Green, Stokes theorems.

Prerequisite: 23105024 General Math I
3.000 Credit hours
Course Type: Theoretical
Course Length: 51 hours

23131068 Statics

Basic concepts; Revision on scalar and vector quantities, Newton's laws, systems of units, force, moment of force, couple. Various force systems and their resultants, free body diagrams, equilibrium of rigid bodies and their equations of equilibrium and reactions determination, static indeterminacy and partial constraints. First and second moments.

1. **Structures (trusses, frames, machines)**

Trusses (method of joints, method of sections), frames and machines.

2. **Distributed-force systems**

Centers of gravity, mass, volume of rigid bodies, composite volumes, areas and lines and their centers.

3. **Beams**

Equations of axial and shear forces and bending moment and their diagrams for the beams under concentrated and distributed loads.

4. **Area moments of inertia**

Definitions of rectangular and polar moments of area, radius of gyration, product of area. Transfer of axes, rotation of axes, principal axes, Mohr's circle.

5. **Friction**

Dry friction laws, friction angle, friction in wedges, screws, dry disk and belts, Rolling resistance

6. **Virtual work**

Method of virtual work and its application in machines. Method of potential energy.

Prerequisite: 23105024 General Math I, 274 Physics I

3.000 Credit hours

Course Type: Theoretical

Course Length: 51 hours

23132049 Computer Programming

Introduction into programming language Fortran and MATLAB, algorithms and sub-algorithms and flowchart, Data types and declarations, statements, expressions and assignment, procedures and functions and subroutines, different types of conditional operations loops, vectors and matrices, subprograms, input and output instructions, common algorithms such as methods of search and arrangement, Files Applications to some numerical problems.

Prerequisite: 23105024 General Math I

3.000 Credit hours

Course Type: Theoretical

Course Length: 51 hours

23131079 Dynamics

1. **Introduction to Dynamics**
2. **Kinematics of Particles:**

Rectilinear motion, Plane curvilinear Motion, rectangular Coordinates, Normal and Tangential Coordinates, Polar Coordinates, Space curvilinear motion, Relative motion, constrained motion of Connected Particles.

3. **Kinetics of Particles:**

Force, Mass, and Acceleration based on Newton's Second law Rectilinear Motion and Curvilinear Motion, work and Kinetic energy, Potential Energy.

Impulse and Momentum, impact, Kinetics of System of Particles.

4. **Plane Kinematics of Rigid Bodies:**

Rectilinear motion, Rotation about Fixed Point, Rotation about Fixed Axis, Angular Velocity and Acceleration, Instantaneous Center of Zero Velocity, Relative Acceleration, Motion relative to rotating axes.

5. **Plane Kinetics of Rigid Bodies:**

General Equation of Motion, work and energy Relations, Impulse and Momentum equations.

6. Three – Dimensional Dynamics of Rigid Bodies
Angular Momentum, Kinetic Energy

Prerequisite: 23131068 Engineering Statics, 274 Physics I
4.000 Credit hours
Course Type: Theoretical
Course Length: 68 hours

23131080 Strength of Materials I

1. Concept of Stress
Definition of stress, types, stress vector

2. Stress Analysis in Members under Axial Loads
Normal stress, stress on an oblique plane, shearing stress, safety factor, ultimate and allowable stresses, an introduction to yield strength of materials, tensile test, Saint-Venant's principle, stress concentration, residual stress, stress in joints (bolt, pin and rivet).

3. Strain and Deformations in Members under Axial Loadings
Definition of strain, stress-strain relations, Hooke's law for axial loading, stress-strain diagrams for different materials, deformation under axial loading, thermal strain, use of deformations compatibility equation for solving different problems, lateral strain, Poisson's ratio, generalized Hooke's law for isotropic materials, volumetric strain and Bulk Modulus, shear strain, design consideration.

4. Torsion
Concept and basic hypothesis, torsional stress and angle of twist in circular shafts, torsion in open and closed thin-walled members, introduction to torsion of noncircular members, stress concentration, allowable shear stress, indeterminate torsional system and compatibility equation, stress concentration, shaft's coupling.

5. Pure Bending
Concept and basic hypotheses, moment and curvature relation, bending stress, bending of members made from several materials, bending in beams under eccentric and unsymmetrical loads, general case of eccentric axial loading, kern of cross-section, design consideration.

6. Shearing and Compound Stresses in Beams
Concept and basic hypothesis, shear flow, shearing stress in beams and its distribution, shearing stress in circular shaft, thin-walled members such as wide flange, angle and channel

7. Transformations of Stress and Strain
Plane stress and plane strain, stress component on oblique plane, principal stresses, maximum shearing stress, Mohr's circle for stress and its drawing method, strain components on oblique plane, principal strains, Mohr's circle for strain, measurements of strain, strain Rosette.

8. Deflection of Beams

Deflection relation in beams, deflection determination with integration method, Macaulay's method, superposition method, boundary conditions.

Prerequisite: 23131068 Engineering Statics
3.000 Credit hours
Course Type: Theoretical
Course Length: 51 hours

23131104 Thermodynamics I

Outlines:

1- Definition of thermodynamics & the application in industry.

2- System & control volume, state, process, properties, units, temperature scale & zeroth law of thermodynamics.

3- Pure substance, definition & properties, quality and thermodynamics tables, equation of state for ideal gases.

4- Work and Heat in thermodynamics

5- Conservation of energy or first law of thermodynamics for control mass and control volume (steady state, steady flow process, uniform state uniform flow process), throttling, Joule-Thompson factor, heat capacity, internal energy, enthalpy, conservation of mass, volumetric & mass flow rate.

6- Heat engines and Heat pumps, thermal efficiency & coefficient of performance second law of thermodynamics, reversible process, and Carnot cycle.

7- The Clausius Inequality, entropy, change of entropy for reversible and irreversible processes, lost work, the increase in Entropy principles.

8- Entropy and change of entropy for ideal gases, efficiency in thermodynamics

9- Irreversibility, reversible work, availability or exergy.

Prerequisite: 274 Physics I, 22205012 Differential Equations
3.000 Credit hours
Course Type: Theoretical
Course Length: 51 hours

23132050 Engineering Mathematics

Fourier analysis, partial differential equations (PDEs), boundary equations, complex numbers and functions. Complex differentiation and integration, power series, Taylor's series, residue integrationRef. Advanced engineering mathematics by Erwin Kreyszig

Prerequisite: 23130010 General Math II, 22205012 Differential Equations

3.000 Credit hours

Course Type: Theoretical

Course Length: 51 hours

23132209 Computer-Aided Machine Design

Learn and apply all of the steps of the computer aided design process in proposing and building models in design projects, Provide the students with a foundation in computer aided design, produce knowledgeable users of CAD systems, Introduce the students to Finite Element Techniques, widen the exposure of the students to contemporary design tools such as optimization and Rapid Prototyping, make the students aware of the capabilities and limitations of computer design tools for engineers, Design and model a mechanical part that meets preset constraints and specifications, Provide engineering documents using computer technology, Conduct an idea to a computer design and distribute the idea within a team by applying the engineering design process steps and documenting and modeling on each phase.

Prerequisite: 23132049 Computer Programming

3.000 Credit hours

Course Type: Theoretical

Course Length: 51 hours

23131137 Fluids Mechanics I

Outlines:

1. Fundamental Concepts of Fluids, Fluid Properties

2. Fluid Statics and Pressure Measurements: Manometry, Hydrostatics Forces, Solid-like motion, Buoyancy, Stability

3. Fluid Kinematics and Reynolds Transport Theorem: Some concepts of fluid motion, Acceleration, Reynolds Transport Theorem

4. Conservation of Mass, Momentum and Energy for Control Volume: Integral form of Continuity, Linear Momentum, Angular Momentum, Conservation of Energy

5. The Bernoulli Equation and Applications: Flow measurements based on Bernoulli equation.

6. Dimensional Analysis and Similitude

7. Viscous Flow in Pipes and Ducts, Reynolds number, Laminar flow, Turbulent Flow, Flow Measurements

Prerequisite: 22205012 Differential Equations, 23131079 Dynamics
3.000 Credit hours
Course Type: Theoretical
Course Length: 51 hours

23132287 Aeronautic Structure Analysis

Properties of wing and fuselage sections. Buckling of beams and plates. Torsion of thin-walled and skin-stringer multiple-cell sections. Failure mechanisms and predictions. Nonsymmetrical bending of skin-stringer sections. Flexural shear in open and closed thin-walled and skin-stringer sections. Deflection by energy method. Introduction to composite structures, Reference: Tomas Henry Gordon Megson, Aircraft structures for engineering students.

Prerequisite: 23131068 Statics, 23131080 Strength of Materials I, 23130010 General Math II
3.000 Credit hours
Course Type: Theoretical
Course Length: 51 hours

23132301 Engine, Airframe and Airplane Systems 1 Workshop

Prerequisite: none
1.000 Credit hours
Course Type: Practical
Course Length: 34 hours

23131115 Thermodynamics - II

1. **A review on thermodynamics- I**
2. **Cycles:**

Rankine Cycle, Effect of Pressure and Temperature on Cycle Performance. Rankine Cycle with Reheat, Rankine Cycle with Regeneration, Deviations between actual and ideal Rankine Cycles. Vapor compression refrigeration cycles, Absorption cycles, Otto and Diesel Cycles, Sterling Cycles, Brayton Cycle, Gas turbine cycle with regeneration, Multi-stage inter-cooling and reheat Gas turbine cycle, Jet Engine Cycle.

3. Mixtures

Mixture of Ideal Gases, mixture of water vapor and dry air, Dry and wet bulb temperature, humidity ratio, relative humidity, application of first law, Psychrometric properties, Psychrometric chart, adiabatic saturation process, mixing process.

4. Thermodynamic Relations

Maxwell's Thermodynamic Relations. Clausius–Clapeyron relation, Calculation of Enthalpy, Internal Energy, and Entropy Using Thermodynamic Relations. Equation of state, Generalized Compressibility chart, Real gas, Ideal Gas, Enthalpy and Entropy deviation Charts from Real Gas.

5. Chemical reactions

Fuels, Combustion process, combustion products, enthalpy of formation, adiabatic flame temperature, enthalpy of combustion, Lower and Higher Heating Values of Fuels.

6. Compressible Flow

Stagnation properties, one-dimensional compressible adiabatic reversible flow, speed of sound, Mach number, Normal shock.

Prerequisite: 23131104 Thermodynamics I
3.000 Credit hours
Course Type: Theoretical
Course Length: 51 hours

23131217 Vibrations

Kinematics of vibration, Undamped and damped free vibration, Vibration under harmonic and general forcing conditions, Two and multi-degree of freedom systems, Analysis of the time-domain response of single-and multiple-degree-of-freedom (DOF) systems to initial conditions and force inputs, Using matrix formulation of multiple-DOF problems, including finding natural frequencies and mode shapes, Continuous systems.

Prerequisite: 23131013 Engineering Mathematics, 23131079 Dynamics
3.000 Credit hours
Course Type: Theoretical
Course Length: 51 hours

23132425 Sheet metal and Welding in Aviation Industry Workshops

Prerequisite: none
1.000 Credit hours
Course Type: Practical
Course Length: 34 hours

23131240 Automatic Control

1. Present an introduction to control system

2. Mathematical modeling of dynamic systems and develops transfer function models and state-space models, block-diagram, signal flow graphs and linearization technique.

3. Transient response analyses of dynamic systems to step, ramp, and impulse input.

4. Mathematical Modeling of Fluid Systems and Thermal Systems -Transient and Steady-State Response Analyses

5. Root-locus analysis and plotting root loci diagram

6. Control Systems Design by the Root-Locus Method -Frequency-Response Analysis.

7. Design and compensation technique and obtain optimal choices of parameter value and design of high performance control systems.

8. Frequency – response analysis, bode diagrams, polar plot, the Nyquist stability criterion and closed-loop frequency response.

9. Routh's stability criterion in the stability analysis of the higher-order systems

Reference: Katsuhiko Ogata, Modern control engineering

Prerequisite: 23131217 Vibrations, 22205012 Differential Equations
3.000 Credit hours
Course Type: Theoretical
Course Length: 51 hours

23132298 Aerodynamics (I)

Fundamental principles and equations, Fundamental of in viscid, incompressible flow, Incompressible flows over airfoils -Incompressible flow over finite wings -Three dimensional incompressible flow Reference: John David Anderson, Fundamentals of Aerodynamic

Prerequisite: 23131079 Dynamics, 23131137 Fluids Mechanics I
3.000 Credit hours
Course Type: Theoretical
Course Length: 51 hours

23132356 Engine, Airframe and Airplane Systems 2 Workshop

Prerequisite: 22113184 Engine, Airframe and Airplane Systems 1 Workshop
1.000 Credit hours
Course Type: Practical
Course Length: 34 hours

23132414 Aeronautic Structure Design

Introduction, Basic elasticity, Torsion of solid section, Energy method for structural Analysis, Bending of thin plates, Aircraft structure, Reference: Tomas Henry Gordon Megson, Aircraft structures for engineering students.

Prerequisite: 23131068 Statics, 23131080 Strength of Materials I, 23130010 General Math II, 23132287 Aeronautic Structure Analysis
3.000 Credit hours
Course Type: Theoretical
Course Length: 51 hours

23105046 Numerical calculations

1. Errors in Numerical Calculations: Errors and their analysis, general error formula, errors in a series approximation.

2. Solution of algebraic and transcendental equations: Bisection method, iteration method, Method of false position, Newton -Raphson method, solution of systems of nonlinear equations, method of iteration

3. Interpolation method:

Errors in polynomial interpretation, finite difference, forward, backward and central difference, Difference of polynomial, Newton's formulae for interpolation, central difference interpolation formulae, Interpolation with unevenly spaced points, Newton's general interpolation formula, and interpolation by iteration.

4. Curve Fitting:

Cubic splines and approximation: introduction, least square curve fitting, Procedures fitting a straight line, nonlinear curve fitting, curve fitting by a sum of exponentials, Data fitting with cubic splines derivation of governing equation, end conditions.

5. Numerical Differentiation and Integration

Numerical differentiation- cubic spline method: maximum and minimum values of a tabulated function; Numerical Integration- trapezoidal rule, Simpson1/3 rule, Simpsons 3/8 rule, Newton-cots integration formulae; Euler-Meclaurin formula, Gaussian integration (One dimensional only)

6. Matrices and Linear systems of equations

Introduction, Inverse of Matrix, Solution of linear systems, Matrix inversion method, Gaussian Elimination method (fall and banded symmetric and un-symmetric systems), Eigen value problems .

7. Numerical solution of ordinary differential equations:

Solution by Taylor's series, Prediction -correction method, Boundary value problems, Prediction corrector method, Euler's and modified Euler's method, Runge-Kutta method, finite difference methods.

8. Numerical solution of Partial differential equations:

Finite difference approximation to derivatives, Solution to Laplace's equation- Jacobi's method, Gauss-Siedel method, S.O.R method, Parabolic equation and their solution using iterative methods

Prerequisite: 23132049 Computer Programming
2.000 Credit hours
Course Type: Theoretical
Course Length: 34 hours

23131251 Strength of Materials Lab. II

1. Hook's Law, Deflection of Cantilever and Simply Supported Beams and Betti-Maxwell's Reciprocity Theorem.

2. Bending Moment and Shearing Force in Beams

3. Hardness and Impact in different Temperature

4. Introduction to Strain Gauges

5. Uniaxial Tension

6. Column Buckling

7. Plastic Torsion in different Materials

8. Fatigue in Beams

9. Leaf and Coil Springs Behavior

10. Stress Distribution in an Angle under Eccentric Loading

Prerequisite: 23131182 Strength of Materials I
1.000 Credit hours
Course Type: Practical
Course Length: 34 hours

23131126 Thermodynamics Lab. II

Selected experiments covering the main subjects of Thermodynamics.

Prerequisite: Thermodynamics II
1.000 Credit hours
Course Type: Practical
Course Length: 34 hours

23132323Aerodynamics (II)

Introduction, Compressible flow principles, Normal and oblique shock wave and expansion wave, Compressible flow through nozzles, diffusers and wind tunnels, Subsonic incompressible flow over airfoil, Supersonic and hypersonic flow, Viscous flow Reference: John David Anderson, Fundamentals of aerodynamics.

Prerequisite: 23132298 Aerodynamics (I)
3.000 Credit hours
Course Type: Theoretical
Course Length: 51 hours

23132334 Flight Mechanics (I)

Introduction, Airplane aerodynamics, Airplane propulsion system, Airplane equation of motions, Airplane Steady flight performance, Airplane accelerated flight performance, Reference: John David Anderson, Aircraft Performance and Design.

Prerequisite: 23132298 Aerodynamics (I), 23131079 Dynamics
3.000 Credit hours
Course Type: Theoretical
Course Length: 51 hours

23133188 Introduction to Finite Elements

course will cover the fundamentals of Finite Element Method (FEM) through typical mechanical engineering examples. Stiffness method will be introduced for the solution procedure. Knowledge of a programming language (MATLAB or Python are preferred) will be very helpful. Application of stiffness method to solve truss, beam, frame, and 1-D fluid flow problems are taught in this course.

Prerequisite: 22205012 Differential Equations, 23131068 Statics, 23132049 Computer Programming
3.000 Credit hours
Course Type: Theoretical
Course Length: 51 hours

23105057 Engineering Statistics and Probability

- Theory of sets
- Samples and their tabular representations together with their mean values
- Expected and median values
- Variance
- Combination and permutation and related theorems
- Random Variables
- Probability density function and cumulative distribution function
- Binomial, Poisson and Normal distributaries
- Multi-Variable distribution function
- Random Numbers
- Random Sampling
- Estimation of statistical parameters
- Decision hypothesis
- Variance analysis
- Regression

- Correlation
- Nonparametric Method

Prerequisite: 23105024 General Math I
3.000 Credit hours
Course Type: Theoretical
Course Length: 51 hours

23132345 Flight Mechanics (II)

•Introduction

• Stability and Control of Aircraft

• General Equations of Unsteady Motion • The Stability Derivatives • Stability of Uncontrolled Motion • Response to Actuation of the Controls-Open Loop

• Closed-Loop Control

• Longitudinal motion • Lateral Motion

Reference: Jan Roskam, Airplane flight dynamics and automatic flight control

Prerequisite: 23131240 Automatic Control, 23132334 Flight Mechanics (I)
3.000 Credit hours
Course Type: Theoretical
Course Length: 51 hours

23132389Airplane Design 1

Introduction During this course we learn about aircraft conceptual and preliminary design based on Jan Roskam text book. The course contents are:

• Requirements development

• Weight estimation

• Cost estimation and constraint diagrams

• preliminary sizing - Design requirement sensitivities

• Weight estimation • Wing area selection

• Power & propulsion system requirements

Reference: Jan Roskam, Airplane Design.

Prerequisite: 23132334 Flight Mechanics (I)
3.000 Credit hours
Course Type: Theoretical
Course Length: 51 hours

23132390 Principle of propulsion

- Introduction
- Jet propulsion principle
- Parametric Cycle Analysis of Real Engines
- Engine Performance Analysis
- Inlets, Nozzles, and Combustion Systems
- Axial compressors
- Axial Turbines
- Centrifugal compressors

Reference: Philip Graham Hill, Carl R. Peterson, Mechanics and thermodynamics of propulsion

Prerequisite: 23132323Aerodynamics (II), 23131115 Thermodynamics II
3.000 Credit hours
Course Type: Theoretical
Course Length: 51 hours

23131035 Fundamentals of Electrical and Power Engineering I

Basic electrical engineering principles, Direct current circuit analysis involving current and voltage, resistance, energy and power, Ohm's law, series and parallel networks. Mesh and nodal analysis, network theorems, R-L and R-C and R-L-C combinations, transients in R-L-C combinations. AC network analysis.

Prerequisite: 273 Physics II.
3.000 Credit hours
Course Type: Theoretical
Course Length: 51 hours

23131091 Materials Science

Introduction to the physical mechanisms that give rise to mechanical properties of engineering materials: stiffness, creep, stress-relaxation, strength, fracture-toughness, and fatigue, effects that manufacturing processes have on the material's properties, Plastic Deformation, phase diagrams, Structure and properties of multi-phase metallic materials, Ceramic materials and their properties,

Prerequisite: none

3.000 Credit hours

Course Type: Theoretical

Course Length: 51 hours

23131193 Heat Transfer I

COURSE OUTLINE: Basic of heat transfer, Conduction heat transfer, Steady-state conduction, Unsteady-state conduction, Transient conduction, Numerical methods in heat transfer, Thermal radiation, Convection heat transfer, Heat exchangers.

Prerequisite: 23131104 Thermodynamics I, 23132050 Engineering Mathematics

3.000 Credit hours

Course Type: Theoretical

Course Length: 51 hours

23132027 Specialized Language (English for Specific Purpose)

English reading texts covering subjects in Aerospace engineering books and journals.

Prerequisite: 251 General English Language

2.000 Credit hours

Course Type: Theoretical

Course Length: 34 hours

23132403 Aircraft Design 2 (Satellite Engineering)

Satellite Engineering introduces students to subsystem design in engineering spacecraft. The course presents characteristic subsystems, such as power, structure, communication and control, and analyzes the engineering trades necessary to integrate subsystems successfully into a satellite. Discussions of spacecraft operating environment and orbital mechanics help students to understand the functional requirements and key design parameters for satellite systems.

Prerequisite: 23132389Airplane Design 1
3.000 Credit hours
Course Type: Theoretical
Course Length: 51 hours

23133202 Introduction to Computational Fluid Dynamics (CFD)

• Introduction: calculation of flow in a rectangular duct

• Calculation of fully developed flow in a triangular duct

• Derivation of equations governing fluid flow

• Equations for incompressible flow and boundary conditions

• Basic concepts of CFD: Finite difference approximations

• Basic concepts of CFD: Consistency, stability and convergence

• Solution of Navier Stokes for compressible flows

• Solution of Navier Stokes equations for incompressible flows

• Solution of linear algebraic equations: basic methods

• Solution of linear algebraic equations: advanced methods

• Basics of finite volume method including grid generation

• Turbulent flows and turbulence modelling

Books and references:

1.Ferziger J.H. & Peric M. (1999) Computational Methods for Fluid Dynamics, Springer, Berlin, Germany.

2.Hirsch C. (1988) Numerical Computation of Internal and External Flows, John Wiley & Sons, New York, USA.

Prerequisite: 23105046 Numerical calculations, 23132050 Engineering Mathematics
3.000 Credit hours
Course Type: Theoretical
Course Length: 51 hours

93132184 Intake Aerodynamics

Introduction to different aspects of engine intake flow and performance parameters of intake. Introducing various types of intakes and design methods. Analyzing normal and oblique shock waves and expansion fan, shock interactions with other shock waves and boundary layer, conical shocks, subsonic and supersonic intakes and buzz phenomena.

Prerequisite: 23132323Aerodynamics (II)
3.000 Credit hours
Course Type: Theoretical
Course Length: 51 hours

23132083 Fuel & Combustion

Introduction (significance of combustion, applications and definitions, Flames), Thermodynamic Basics, Properties of gaseous and liquid fuels. Gas mixtures. Stoichiometric analysis. Chemical equilibrium. Conservation equations of reacting flows. Chemical kinetics.

Prerequisite: 23131115 Thermodynamics - II
2.000 Credit hours
Course Type: Theoretical
Course Length: 34 hours

23133019 Specialized Project (Bachelor Project)

• Experimental investigation of cooling electronic devices by direct liquid contact using jet impingement and spray injection.

Prerequisite: none
3.000 Credit hours
Course Type: Practical
Course Length: 51 hours

23133053 Welding Workshop

Introduction to welding and cutting, safety in welding and cutting, welding with oxy-acetylene, devices and equipment of oxy-acetylene cutting, cutting with oxy-acetylene, dross devices and equipment in oxy-acetylene, welding with direct current, devices and equipment of direct current welding, welding with electric arc, soldering, resistance welding, full description of different facilities of bending and ways of usages. Making cylindrical pipes, piping with hands and rollers, Sheets-bending With sheet bending machines.

Prerequisite: none
1.000 Credit hours
Course Type: Practical
Course Length: 34 hours

23163102 Apprenticeship

•Internship in MAPNA group company, power engineering division.

•Participant in research and development about turbine inlet air cooling systems, types of fuels and equipment and modern combined cycle power plants.

Prerequisite: none
1.000 Credit hours
Course Type:
Course Length: 304 hours

251 General Foreign language

General English for Engineering

Prerequisite: none
3.000 Credit hours
Course Type: Theoretical
Course Length: 51 hours

250 General Farsi (Persian literature)

A review on the prominent proses and poems of the Persian literature through the history of Iran. A review on the Persian grammar for writing.

Prerequisite: None.
3.000 Credit hours
Course Type: Theoretical
Course Length: 51 hours

21443005 Student Life Skills

Basic knowledge about Ethics

2.000 Credit hours
Course Type: Theoretical
Course Length: 34 hours

524 Applied Islamic Gnosticism

Basic knowledge about Gnosticism in Islam

2.000 Credit hours
Course Type: Theoretical
Course Length: 34 hours

551 Thematic Quran Commentary

Basic knowledge about Quran

2.000 Credit hours
Course Type: Theoretical
Course Length: 34 hours

525 Family knowledge and population

Basic knowledge about Family

2.000 Credit hours
Course Type: Theoretical
Course Length: 34 hours

542 Analytic History of Early Islam

Basic knowledge about Islam

2.000 Credit hours
Course Type: Theoretical
Course Length: 34 hours

220 PE (Physical Education)

1.000 Credit hours
Course Type: Practical
Course Length: 17 hours

221 Sports I

1.000 Credit hours
Course Type: Practical
Course Length: 17 hours

533 Imam Khomeini's Political Thoughts

Basic knowledge about Politics

2.000 Credit hours
Course Type: Theoretical
Course Length: 34 hours

511 Islamic Thoughts I

Basic knowledge about Islam

2.000 Credit hours
Course Type: Theoretical
Course Length: 34 hours

512 Islamic Thoughts II

Basic knowledge about Islam and prophets

2.000 Credit hours
Course Type: Theoretical
Course Length: 34 hours