CURRICULUM OF
MS IN AEROSPACE ENGINEERING

College of Aeronautical Engineering
National University of Sciences and Technology
Permanent Faculty: Aerospace Engineering Department

- Dr Ibraheem Haneef  Aerospace (MEMS for aerospace)
- Dr Nadeem Shafi  Aerospace (Structures)
- Dr Liaqatullah  Aerospace (Multidisciplinary Design Opt)
- Dr Messam Naqvi  Aerospace (Multidisciplinary Design Opt)
- Dr Syed Irtiza Ali  Aerospace (Flight Mechanics & Controls)
- Dr Ali Sarosh  Astronautics (Space Technology)
- Dr Kamran Asim  Aerospace (Manufacturing)
- Dr Shoaib Salamat  Aerospace (Aircraft design)
- Dr Athar Kharal  Mathematics
- Dr Faisal Siddiqui  Aerospace (structures)
- Dr Ali Javed  Aerospace (Fluid Structure Interaction)
Contents

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INTRODUCTION

Since its inception in 1965, over the last 50 years, College of Aeronautical Engineering (CAE) has developed itself into a premier institute for imparting both undergraduate and postgraduate education in the field of Aeronautical Engineering. During the last 21 years, under the auspicious umbrella of NUST, the College has progressed immensely in terms of faculty development, infrastructure and upgradation of laboratories and IT facilities. The college is not only producing qualified engineers for Pakistan and a number of friendly countries, but had also graduated eight MS courses from 1997 to 2006 in the disciplines of Aerospace Engineering and Avionics Engineering.

MISSION

To produce graduate and qualified researchers in Aerospace Engineering discipline to fulfill the requirements of Aeronautical Engineering sector in the country.

OBJECTIVES

The educational objectives of the program in Aerospace Engineering are to produce graduates:-

- Who are employable with adequate knowledge and competency in Aerospace Engineering.
- Who demonstrate the capacity to assume social, environmental and ethical responsibility in the national and global perspective.
- Who have capability to be effective team members and take a leadership role in research, design, innovation, implementation and operation of Aerospace systems and equipment.
- Who can communicate effectively and possesses an enduring desire to continuously enhance their knowledge through life-long learning.

ELIGIBILITY CRITERIA

- Sixteen years of schooling or 4 years (minimum 124 credit hours) education after HSSC / A-Level in relevant discipline (Mechanical, Civil, Aerospace Engineering or closely relevant discipline)
- Minimum GPA of 2.00
- At least 50% marks in GAT (General) conducted by NTS or GRE general conducted by ETS USA with 650/800 or 151/170 in Quantitative, 400/800 or 146/170 in Verbal and 3.5/6.0 in Analytical.
**ASSESSMENT METHODOLOGY**

<table>
<thead>
<tr>
<th>Nature of Exam</th>
<th>Duration</th>
<th>Frequency</th>
<th>Weightage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>End Semester Exam</td>
<td>2-3 hours</td>
<td>1</td>
<td>40-50</td>
</tr>
<tr>
<td>One Hour Tests</td>
<td>1 hour</td>
<td>1 credit hr course: min 1 OHT</td>
<td>30-40</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2-4 cr hr course: min 2 OHTs</td>
<td></td>
</tr>
<tr>
<td>Quizzes</td>
<td>10 min generally</td>
<td>1 cr hr course: min 2 2-4 cr hr course: min 3</td>
<td>10-15</td>
</tr>
<tr>
<td>Assignments</td>
<td>As specified by Professor</td>
<td>As specified by Professor</td>
<td>5-10</td>
</tr>
<tr>
<td>Projects</td>
<td>As specified by Professor</td>
<td>As specified by Professor</td>
<td>10-20</td>
</tr>
<tr>
<td>Lab Work / Projects</td>
<td>3 contact hours</td>
<td>1 per week for each lab cr hr</td>
<td>70-80 of lab cr hr</td>
</tr>
</tbody>
</table>

**GRADING SCHEME**

<table>
<thead>
<tr>
<th>Letter Grade</th>
<th>Grade Point</th>
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<tbody>
<tr>
<td>A</td>
<td>4.00</td>
</tr>
<tr>
<td>B+</td>
<td>3.50</td>
</tr>
<tr>
<td>B</td>
<td>3.00</td>
</tr>
<tr>
<td>C+</td>
<td>2.50</td>
</tr>
<tr>
<td>C</td>
<td>2.00</td>
</tr>
<tr>
<td>F</td>
<td>0.00</td>
</tr>
<tr>
<td>I</td>
<td>Incomplete</td>
</tr>
<tr>
<td>W</td>
<td>Withdrawn/Dropped</td>
</tr>
</tbody>
</table>

**STRUCTURE OF MS PROGRAM**

<table>
<thead>
<tr>
<th>Courses</th>
<th>Credit Hours</th>
<th>GPA/Non GPA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core</td>
<td>9-12</td>
<td>GPA</td>
</tr>
<tr>
<td>Electives</td>
<td>12-15</td>
<td>GPA</td>
</tr>
<tr>
<td>Additional</td>
<td>2 (RM-898)</td>
<td>Non-GPA</td>
</tr>
<tr>
<td>Thesis</td>
<td>6</td>
<td>GPA</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>30+2</strong></td>
<td><strong>30 GPA + 2 NON-GPA</strong></td>
</tr>
</tbody>
</table>
**COURSES: MS IN AEROSPACE ENGINEERING**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core Courses (Minimum 3 required)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AE-811</td>
<td>Theory of Elasticity</td>
<td>3</td>
</tr>
<tr>
<td>AE-831</td>
<td>Turbomachinery</td>
<td>3</td>
</tr>
<tr>
<td>MA-844</td>
<td>Advanced Engineering Mathematics</td>
<td>3</td>
</tr>
<tr>
<td>Electives (5 Courses are required)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AE-812</td>
<td>Finite Element Methods</td>
<td>3</td>
</tr>
<tr>
<td>AE-813</td>
<td>Advanced Theory of Vibrations</td>
<td>3</td>
</tr>
<tr>
<td>AE-814</td>
<td>Advanced Mechanics of Composites</td>
<td>3</td>
</tr>
<tr>
<td>AE-815</td>
<td>Aeroelasticity</td>
<td>3</td>
</tr>
<tr>
<td>AE-822</td>
<td>Advanced Aerodynamics – II : Compressible Flows</td>
<td>3</td>
</tr>
<tr>
<td>AE-823</td>
<td>Computational Fluid Dynamics - I</td>
<td>3</td>
</tr>
<tr>
<td>AE-832</td>
<td>Advanced Heat Transfer</td>
<td>3</td>
</tr>
<tr>
<td>AE-841</td>
<td>Advanced Flight Dynamics &amp; Control</td>
<td>3</td>
</tr>
<tr>
<td>AE-851</td>
<td>Multidisciplinary Design Optimization for Aerospace Vehicles</td>
<td>3</td>
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<tr>
<td>AE-861</td>
<td>Micro-Electro-Mechanical-Systems (MEMS) for Aerospace Applications</td>
<td>3</td>
</tr>
<tr>
<td>AE-871</td>
<td>Computer Aided Engineering</td>
<td>3</td>
</tr>
<tr>
<td>MA-845</td>
<td>Data Analytics</td>
<td>3</td>
</tr>
<tr>
<td>IE-801</td>
<td>Industrial Management &amp; System Engineering</td>
<td>3</td>
</tr>
<tr>
<td>AE-921</td>
<td>Computational Fluid Dynamics –II</td>
<td>3</td>
</tr>
<tr>
<td>Relevant Electives that could be taken at other institutes of NUST</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ME-835 / CSE910</td>
<td>Advanced Mechanics of Materials (at SMME / RCMS/CEME)</td>
<td>3</td>
</tr>
<tr>
<td>CE-801</td>
<td>Advanced Structural Mechanics (at MCE)</td>
<td>3</td>
</tr>
<tr>
<td>CE-809</td>
<td>Structural Dynamics (at MCE)</td>
<td>3</td>
</tr>
<tr>
<td>EM-806</td>
<td>Operations Research (at SMME/CEME)</td>
<td>3</td>
</tr>
<tr>
<td>ME-810</td>
<td>Principles of Control Systems (at SMME)</td>
<td>3</td>
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<tr>
<td>ME-819</td>
<td>Instrumentation &amp; Data Acquisition Systems (at SMME/CEME)</td>
<td>3</td>
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<tr>
<td>ME-820</td>
<td>Advanced Instrumentation and Experimental Methods (at SMME/CEME)</td>
<td>3</td>
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<tr>
<td>ME-834</td>
<td>Fracture Mechanics (at CEME)</td>
<td>3</td>
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<tr>
<td>ME-854</td>
<td>Computer Integrated Manufacturing (at SMME/CEME)</td>
<td>3</td>
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<tr>
<td>ME-869</td>
<td>Project Management (at SMME/CEME)</td>
<td>3</td>
</tr>
<tr>
<td>Additional Course</td>
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<tr>
<td>RM 898</td>
<td>Research Methodology</td>
<td>2</td>
</tr>
</tbody>
</table>
# TYPICAL SCHEME OF STUDIES

## Specialty Stream 1: Solid Mechanics/ Structural Design and Analysis

<table>
<thead>
<tr>
<th>1&lt;sup&gt;st&lt;/sup&gt; Semester</th>
<th>2&lt;sup&gt;nd&lt;/sup&gt; Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory of Elasticity</td>
<td>Finite Element Methods</td>
</tr>
<tr>
<td>Advanced Engineering Mathematics</td>
<td>Data Analytics</td>
</tr>
<tr>
<td>Turbomachinery</td>
<td>Advanced Theory of Vibrations</td>
</tr>
</tbody>
</table>

## Specialty Stream 2: Fluid Dynamics/Aerodynamics

<table>
<thead>
<tr>
<th>1&lt;sup&gt;st&lt;/sup&gt; Semester</th>
<th>2&lt;sup&gt;nd&lt;/sup&gt; Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory of Elasticity</td>
<td>Computational Fluid Dynamics - II</td>
</tr>
<tr>
<td>Advanced Engineering Mathematics</td>
<td>Data Analytics</td>
</tr>
<tr>
<td>Turbomachinery</td>
<td>Computational Fluid Dynamics - I</td>
</tr>
</tbody>
</table>

## Specialty Stream 3: Thermo-fluids / Propulsion

<table>
<thead>
<tr>
<th>1&lt;sup&gt;st&lt;/sup&gt; Semester</th>
<th>2&lt;sup&gt;nd&lt;/sup&gt; Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced Aerodynamics – II: Compressible Flows</td>
<td>Computational Fluid Dynamics – I</td>
</tr>
<tr>
<td>Advanced Engineering Mathematics</td>
<td>Computational Fluid Dynamics – II</td>
</tr>
<tr>
<td>Turbomachinery</td>
<td>Data Analytics</td>
</tr>
</tbody>
</table>

### Notes:

- RM-898 Research Methodology will be taught in 3<sup>rd</sup> Semester to all specialty streams.
- AE-899 Master Thesis Research will be done in 3<sup>rd</sup> and subsequent semesters for all specialty streams
COURSE DESCRIPTIONS

AE-811 Theory of Elasticity

Credit Hours: 3

Pre-Requisites: Nil

Course Objectives

To impart engineering knowledge and to develop problem analysis and solving ability of Theory of Elasticity for Aerospace Engineering problems.

Course Contents

- Description and Notation
- Plane Stress and Plane Strain
- Two dimensional Problems in Rectangular Coordinates
- Two dimensional Problems in Polar Coordinates
- Two dimensional Problems in Curvilinear Coordinates
- Analysis of Stress and Strain in Three Dimensions
- General Theorems
- Elementary Problems of Elasticity in Three Dimensions
- Torsion
- Bending of Bars
- Axisymmetric Stress and Deformation in a Solid of Revolution
- Thermal Stress

Course Outcomes

After studying this course, the graduate will be able to apply the acquired knowledge in various research areas of Theory of Elasticity in Aerospace Engineering.

Recommended Readings (Text book and References)

- I. S. Sokolnikoff, “Mathematical Theory of Elasticity”
- Ernest E. Sechler., “Elasticity in Engineering”
- Sadhu Sigh., “Theory of Elasticity”

Credit Hours: 3

Pre-Requisites: BE level Fluid dynamics/Aerodynamics course

Course Objectives
To impart engineering knowledge and to develop problem analysis and solving ability of Advanced Incompressible Aerodynamics for Aerospace Engineering problems.

Course Contents
- Introduction to continuum approach
- Kinematic of fluid motion and basic laws
- Newtonian fluid and Navier-Stokes equations
- Exact solutions of Navier - Stokes eqns
- Stream function & velocity potential
- High Reynolds number flows
- Ideal flows in a plane (2-D potential flow)
- Low Reynolds number flows
- Introduction to Turbulent flows

Course Outcomes
After studying this course, the graduate will be able to apply the acquired knowledge in various research areas of Advanced Engineering Mathematics in Aerospace Engineering.

Recommended Readings (Text book and References)
AE-831  Turbomachinery

Credit Hours: 3

Pre-Requisites: Nil

Course Objectives

To impart engineering knowledge and to develop problem analysis and solving ability of Turbomachinery for Aerospace Engineering problems.

Course Contents

- Dimensional Analysis
- Cavitation
- Euler's Equation of Motion
- Definitions of efficiency
- Cascade Analysis (two-dimensional)
- Lift and Drag
- Cascade Test Results
- Off-Design Performance
- Thermodynamics of Axial Flow Turbine Stage
- Stage losses and efficiency
- Soderberg Correlation
- Theory of axial flow turbines
- Turbine flow characteristics
- Multistage Turbine
- Two-dimensional Analysis of Axial Flow Comp
- Axial flow compressor stage losses and efficiency
- Stage loading
- Stage Pressure Rise
- Pressure ratio of Multi-stage compressor
- Characteristics Map of axial flow compressor
- Three-dimensional flows in Axial Turbomachines
- Theory of Radial Equilibrium
- Blade design
- Off-design performance analysis
- Centrifugal compressor, Pump, Fans
- Theoretical analysis of centrifugal compressor
- Concept of Pre-whirl, slip Factor in Centrifugal Comp
- Radial Flow Turbines
- Types of inward Flow radial Turbines
Course Outcomes

After studying this course, the graduate will be able to apply the acquired knowledge in various research areas of Turbomachinery in Aerospace Engineering.

Recommended Readings (Text book and References)

- “Fluid Mechanics, Thermodynamics of Turbomachinery” By S.L. Dixon
- “Mechanics and Thermodynamics of Propulsion” by P. Hill & C. Peterson
- “Gas Turbine Theory” by H. Cohen, G.F.C. Rogers, H.I.H Saravanamutto

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MA-844 Advanced Engineering Mathematics

Credit Hours: 3

Pre-Requisites: Nil

Course Objectives

To impart engineering knowledge and to develop problem analysis and solving ability of Advanced Engineering Mathematics for Aerospace Engineering problems.

Course Contents

- Differential Equations
- Matrices as geometrical transformations, Matrix decompositions
- Vector Analysis
- Transformations of Laplace, Fourier and z
- Conformal Mapping
- special functions (Green, Bessel and Hankel)

Course Outcomes

After studying this course, the graduate will be able to apply the acquired knowledge in various research areas of Advanced Engineering Mathematics in Aerospace Engineering.

Recommended Readings (Text book and References)

- User guide for Maple 2015.
AE-812 Finite Element Methods

Credit Hours: 3

Pre-Requisites: Nil

Course Objectives

To impart engineering knowledge and to develop problem analysis and solving ability of Finite Element Methods for Aerospace Engineering problems.

Course Contents

- Finite element analysis of solids, structures, fluid-flows, fluid-structure interactions, steady-state and transient problems.
- Use of a general finite element computer program.
- The formulation of finite element methods for linear static analysis of solids and structures.
- The displacement-based finite element procedures, when they are effective, and mixed finite element methods for almost incompressible media and beams, plates and shells.
- The formulation of finite element methods for nonlinear static analysis.
- The formulation of finite element methods for fluid flows:
- The formulation of finite element methods for fluid-structure interactions:
- The appropriate use of finite element procedures.

Course Outcomes

After studying this course, the graduate will be able to apply the acquired knowledge in various research areas of Finite Element Methods in Aerospace Engineering.

Recommended Readings (Text book and References)

- "Finite Element Procedures" by K. J. Bathe. (text book)
- "An Introduction to the Finite Element Method" by J N Reddy.
- "Numerical Methods & Software for Dynamic Analysis of Plates & Shells" by Ernest Hinton.
- "Concept & Application of Finite Element Methods" by Robert D. Cook.
AE-813 Advanced Theory of Vibrations

Credit Hours: 3

Pre-Requisites: Nil

Course Objectives

To impart engineering knowledge and to develop problem analysis and solving ability of Advanced Theory of Vibrations for Aerospace Engineering problems.

Course Contents

- Determination of Natural Frequency and Mode Shapes
- Continuous Systems
- Vibration control and measurement
- Non linear Vibration
- Random Vibration

Course Outcomes

After studying this course, the graduate will be able to apply the acquired knowledge in various research areas of Advanced Theory of Vibrations in Aerospace Engineering.

Recommended Readings (Text book and References)

- “Mechanical Vibrations”, by Signiresu S Rao (text book)
- “Vibration of Mechanical and Structural System” by James, Smith, Wolford, and Whaley.
- “Mechanical Vibrations” by Rolland.

AE-814 Advanced Mechanics of Composites

Credit Hours: 3

Pre-Requisites: Nil

Course Objectives

To impart engineering knowledge and to develop problem analysis and solving ability of Advanced Mechanics of Composites for Aerospace Engineering problems.

Course Contents
Finite element analysis of solids, structures, fluid-flows, fluid-structure interactions, steady-state and transient problems.

- Use of a general finite element computer program.
- The formulation of finite element methods for linear static analysis of solids and structures.
- The formulation of finite element methods for nonlinear static analysis.
- The formulation of finite element methods for fluid flows.
- The formulation of finite element methods for fluid-structure interactions.
- The appropriate use of finite element procedures.

Course Outcomes

After studying this course, the graduate will be able to apply the acquired knowledge in various research areas of Advanced Mechanics of Composites in Aerospace Engineering.

Recommended Readings (Text book and References)

- "Finite Element Procedures" by K. J. Bathe. (text book)
- "An Introduction to the Finite Element Method" by J N Reddy.
- "Numerical Methods & Software for Dynamic Analysis of Plates & Shells" by Ernest Hinton.
- "Concept & Application of Finite Element Methods" by Robert D. Cook.

AE-815 Aeroelasticity

Credit Hours: 3

Pre-Requisites: Nil

Course Objectives

To impart engineering knowledge and to develop problem analysis and solving ability of Aeroelasticity for Aerospace Engineering problems.
Course Contents

- Introduction to aeroelasticity
- Static aeroelasticity
- Dynamic aeroelasticity
- Non-Steady Aerodynamics
- Stall flutter
- FSI modeling
- Aeroelasticity in rotorcraft
- Aeroelasticity in Turbo-machines
- Experimental aeroelasticity
- Non-Linear aeroelasticity
- Aeroelastic control

Course Outcomes

After studying this course, the graduate will be able to apply the acquired knowledge in various research areas of Aeroelasticity in Aerospace Engineering.

Recommended Readings (Text book and References)

- “A Modern Course in Aeroelasticity”, by Earl Dowell (5th Ed 2014), Springer Cham Heidellberg.

AE-822 Advanced Aerodynamics – II : Compressible Flows

Credit Hours: 3

Pre-Requisites: Nil

Course Objectives

To impart engineering knowledge and to develop problem analysis and solving ability of Advanced Compressible Aerodynamics for Aerospace Engineering problems.

Course Contents

- Introduction to compressible flow
Course Outcomes

After studying this course, the graduate will be able to apply the acquired knowledge in various research areas of Advanced Compressible Aerodynamics in Aerospace Engineering.

Recommended Readings (Text book and References)

- “Modern Compressible Flow” 2th Ed. By White

AE-823  Computational Fluid Dynamics – I

Credit Hours: 3

Pre-Requisites: Nil

Course Objectives

To impart engineering knowledge and to develop problem analysis and solving ability of Computational Fluid Dynamics for Aerospace Engineering problems.

Course Contents

- Comparison of Experimental, Theoretical and Numerical approaches and Historical perspective.
- Partial differential equations
- System of Equations
- Other deferential equation of interest
- Basic of finite-difference method and introduction
- Finite Differences
- Difference representation of partial differential equations
- Example of methods of obtaining finite-difference methods
- Use of irregular meshes
- Stability considerations
- Application of finite-difference method to select model
- Wave equation
- Heat Equation
- Laplace Equation
- Inviscid equation
- Viscous equation

Course Outcomes

After studying this course, the graduate will be able to apply the acquired knowledge in various research areas of Computational Fluid Dynamics in Aerospace Engineering.

Recommended Readings (Text book and References)

- “Computational Fluid Mechanics and Heat transfer” by Dale A. Anderson, John C Tanehill, Richard H pletcher

AE-832 Advanced Heat Transfer

Credit Hours: 3

Pre-Requisites: Nil

Course Objectives

To impart engineering knowledge and to develop problem analysis and solving ability of Advanced Heat Transfer for Aerospace Engineering problems.

Course Contents

- Differential equation of heat conduction
- Heat conduction equation in different orthogonal Coordinates
- Boundary conditions
- Methods of solution of heat conduction problems
- Method of separation of variables
- Separation of variables method applied to heat
- Conduction equation
- Extended Surfaces
- Laplace transformations method applied to heat
- Conduction problems
• Equations of mass, momentum and energy conservation (Convection)
• 1-D solutions (Convection)
• Laminar boundary layers
• Turbulent flow
• Laminar to turbulent transition
• Time averaged equations
• Eddy viscosity and diffusivity
• Universal velocity profile
• Natural convection
• Radiation - Black body
• Non-black surfaces
• Radiation interchange between surfaces
• Gas radiation

Course Outcomes
After studying this course, the graduate will be able to apply the acquired knowledge in various research areas of Advanced Heat Transfer in Aerospace Engineering.

Recommended Readings (Text book and References)
• “Heat Conduction” by Ozisik
• “Convective Heat Transfer” 2nd Ed. By Burmeister
• “The Radiation Heat Transfer” 2th Ed. By Siegel & Howell

AE-841  Advanced Flight Dynamics & Control

Credit Hours: 3

Pre-Requisites: Nil

Course Objectives
To impart engineering knowledge and to develop problem analysis and solving ability of Advanced Flight Dynamics & Control for Aerospace Engineering problems.

Course Contents
• Analytical tools
• Static stability and control concepts
• Unsteady motion
• Stability derivatives
• Stability of uncontrolled motion
• Open loop response to actuation of controls
• Closed loop control of aircraft

Course Outcomes

After studying this course, the graduate will be able to apply the acquired knowledge in various research areas of Advanced Flight Dynamics & Control in Aerospace Engineering.

Recommended Readings (Text book and References)

• Dynamics of Flight by Bernard Edkin and Lloyd Reid
• Dynamics of Atmospheric flight by Bernard Edkin and Lloyd Reid

AE-851 Multidisciplinary Design Optimization for Aerospace Vehicles

Credit Hours: 3
Pre-Requisites: Nil

Course Objectives

To impart engineering knowledge and to develop problem analysis and solving ability of Multidisciplinary Design Optimization for Aerospace Engineering problems.

Course Contents

• Basic convexity concepts.
• Convexity and optimization.
• Review of linear and non-linear constrained optimization formulations.
• Scalar versus vector optimization problems from systems engineering and architecting of complex systems.
• Heuristic search methods: simulated annealing, genetic algorithms.
• Sensitivity, tradeoff analysis, goal programming and iso-performance.
• Engineering systems modeling for design and optimization.
• Selection of design variables, objective functions and constraints.
• Overview of principles, methods and tools in multidisciplinary design optimization (MDO) for systems.
• Subsystem identification, development and interface design.
• Multi-objective optimization and Pareto optimality.
• Specific applications from aerospace, industrial and electrical engineering.
Course Outcomes

After studying this course, the graduate will be able to apply the acquired knowledge in various research areas of Multidisciplinary Design Optimization in Aerospace Engineering.

Recommended Readings (Text book and References)


AE-861 Micro-Electro-Mechanical-Systems (MEMS) for Aerospace Applications

Credit Hours: 3
Pre-Requisites: Nil

Course Objectives

To impart engineering knowledge and to develop problem analysis and solving ability of Micro-Electro-Mechanical-Systems (MEMS) for Aerospace Engineering problems.

Course Contents

- Introduction to MEMS and mic-fabrication
- Electrostatic sensing and actuation
- Piezo-resistive sensors
- Magnetic actuation
- Surface Micromachining
- Polymer MEMS

Course Outcomes

After studying this course, the graduate will be able to apply the acquired knowledge in various research areas of Micro-Electro-Mechanical-Systems (MEMS) in Aerospace Engineering.
Recommended Readings (Text book and References)

- Practical MEMS by Ville Kaajakari.

AE-871  Computer Aided Engineering

Credit Hours: 3
Pre-Requisites: Nil

Course Objectives

To impart engineering knowledge and to develop problem analysis and solving ability of Computer Aided Engineering for Aerospace Engineering problems.

Course Contents

- Introduction, automation
- Automation, Hard automation, Soft automation
- CNC and feature-based programming for multi-axes CNC
- Kinematic and mechanistic modules for single and Multi point modeling
- Flexible Fixturing, Design for assembly
- Design for Disassembly and services
- Introduction to Manufacturing Systems
- Computer Integrated Manufacturing
- Computer Aided Design and Engineering
- Computer Aided Manufacturing
- Computer Aided Process Planning (CAPP) System
- Computer simulation of Manufacturing Process
- Flexible Manufacturing System
- Just-in-Time Production
- Factory of the Future

Course Outcomes

After studying this course, the graduate will be able to apply the acquired knowledge in various research areas of Computer Aided Engineering in Aerospace Engineering.

Recommended Readings (Text book and References)

- “Manufacturing Engineering and technology” by KALPAK JIAN 3rd Ed (text book)
- CAD/CAM, Theory and Practice by Zeid
MA-845  Data Analytics

Credit Hours:  3

Pre-Requisites:  Nil

Course Objectives

To impart engineering knowledge and to develop problem analysis and solving ability of Data Analytics for Aerospace Engineering problems.

Course Contents

- MATLAB and RapidMiner
- Introduction
- Doing of basic to medium level computational tasks in MATLAB
- Programming in MATLAB: quick refresher
- Numerical Analysis
- Curve and Surface fitting
- Numerical Derivative and Quadrature
- Numerical Solution of Differential Equations
- Applied Statistics
- T-test
- ANOVA
- Chi-square
- Regression and correlation
- Data Mining
- Doing of basic to medium level computational tasks RapidMiner
- Feature Reduction
- Function approximation vs. Classification tasks
- Artificial Neural Networks
- Nearest neighbourhood classification and clustering
- Induction Trees

Course Outcomes

After studying this course, the graduate will be able to apply the acquired knowledge in various research areas of Data Analytics in Aerospace Engineering.

Recommended Readings (Text book and References)

- RapidMiner 6 Manual
IE-801 Industrial Management & System Engineering

Credit Hours: 3

Pre-Requisites: Nil

Course Objectives

To impart engineering knowledge and to develop problem analysis and solving ability of Industrial Management & System Engineering for Aerospace Engineering problems.

Course Contents

- Introduction to Manufacturing Systems
- Single Station manufacturing Cells
- Manual Assembly Lines
- Automated Production Lines
- Automated Assembly System
- Cellular Manufacturing

Course Outcomes

After studying this course, the graduate will be able to apply the acquired knowledge in various research areas of Industrial Management & System Engineering in Aerospace Engineering.

Recommended Readings (Text book and References)

AE-921 Computational Fluid Dynamics –II

Credit Hours: 3

Pre-Requisites: Nil

Course Objectives

To impart engineering knowledge and to develop problem analysis and solving ability of Advanced Computational Fluid Dynamics for Aerospace Engineering problems.

Course Contents

- Introduction to application of numerical methods
- Application to Euler Equation
- Transformation of governing equation
- Finite Difference formulation
- Numerical Methods for Reynold’s averaged NS equation
- Viscous Flows around airfoils
- Introduction To Turbulence Modeling
- Introduction to grid generation
- Algebraic methods of grid generation
- Differential equation methods of grid generation
- Application of finite-difference methods to Reynold's average NS equation

Course Outcomes

After studying this course, the graduate will be able to apply the acquired knowledge in various research areas of Advanced Computational Fluid Dynamics in Aerospace Engineering.

Recommended Readings (Text book and References)