Course Descriptions

MMJ 1010 Graduate Seminar

Graduate Seminar is an academic talk, research seminar or colloquium conducted or selected by the Graduate Study Committee that contributes to the advancement of knowledge in the field of mechanical engineering or that contributes to professional development of the students.

MMJ 2013 –2023 Independent Study/Special Topic I & II

Independent Study is a guided learning and supervision on the study a particular subject of interest in the field of mechanical engineering that is listed as a graduate subject by the faculty or by any other reputable institutions of higher learning. Special Topic is a guided learning and supervision on the study a particular topic of interest in the field of mechanical engineering that exposes the students to the leading edge research, knowledge, and cutting edge technologies. Open to master of engineering students. Investigation carried out under the direction of a member of the graduate faculty. Permission of instructor and approval of the Graduate Study Committee is required.

MMJ 1113 Computational Methods for Engineers

Basic linear algebra, parabolic partial differential equations (PDE), elliptic PDE, hyperbolic systems, hyperbolic equations of the second order, application in engineering.

MMJ 1213 Advanced Engineering Mathematics

Series, Boundary Value Problems (BVP) and Initial Value Problems (IVP) in ODEs, Partial Differential Equations, Selected Topics in Calculus of Variations & Applications, Selected Topics in Integral Equations and Applications.

MMJ 1223 Instrumentation, Measurement and Control

Measurement, Signal Conditioning, Transducers, Basic Control Theory, Computer Aided Design and Simulation.

THERMOFLUIDS

MMJ 1313 Advanced Fluid Mechanics
Introduction to potential flow, compressible flow, and viscous flow including lubrication and boundary layers. Applications to be discussed will be selected from topics in piping networks, turbomachinery, computational methods, turbulence and measurement techniques.

MMJ 1323 Compressible Flow
Fundamental Concepts of Compressible Fluid Dynamics, Normal Shock Waves, Oblique and Conical Shock Waves, Prandtl-Meyer Flows and Shock-Expansion Procedure, Simple One-dimensional Flow Formulations, Simple Area Change (Isentropic), Other Simple Flows, Non-simple and Generalized Flows, The Method of Characteristics.

MMJ 1333 Computational Fluid Dynamics (CFD)
The Governing Equations of Fluid Dynamics, Mathematical Behaviour of PDE's: Impact on CFD, Basic Aspects of Discretisation, Grids with Appropriate Transformations, Some Simple CFD Techniques, Numerical Solutions of Quasi 1-D Nozzle Flows, Numerical Solutions of 2-D Supersonic Flow, Numerical Solutions of Supersonic Flow over a Flat Plate: Numerical Solutions by Solving the Complete Navier-Stokes Equations, Advanced Topics in CFD.

MMJ 1413 Advanced Engineering Thermodynamics
Basics of Thermal Sciences, performance improvement of thermal devices, advanced first and second law of thermodynamics, exergy analysis, gas mixtures and multiphase systems in combustion and air condition system, statistical thermodynamics, Fundamental Equation and Partition Functions.

MMJ 1423 Energy Management
This course will examine a wide array of new energy technologies being proposed to improve energy efficiency, promote the transition to renewable resources and reduce or eliminate adverse environmental impacts. It will review the energy cycle from exploration, extraction, conversion, distribution, and the application and impact of new technologies to increase the amount and delivery of traditional fuel supplies. Also, new technologies to produce energy from wind, water, solar, geothermal and biomass will be analysed. Research efforts in fuel cells, batteries, electric vehicles and engine efficiency by various organizations and governments are also examined.

MMJ 1433 Advanced Heat Transfer

Advanced theories and classical, modern, and complimentary methods of solving engineering heat transfer

Problems, Multidimensional Conduction, Convection, Heat Transfer with Phase Change, Fundamentals of Radiation Heat Transfer, Solution Methods in Radiation Heat Transfer.

MMJ 1443 Advanced Combustion

Flame classification, thermodynamics of combustion processes, chemical kinetics, conservation equations for reacting flows, turbulent reacting flows, ignition and stability, pollutant formation, current topics.

MMJ 1453 Sustainable Energy Technology

Introduction to sustainable development, energy and climate change, thermal energy systems, energy resources and renewable technologies, impact and indicators.

MMJ 1463 Computational Heat Transfer

Mathematical background, finite difference method, finite element method, computational conduction heat transfer, computational convection heat transfer, computational radiation heat transfer.

MMJ 2413 Thermo Fluid Measurement and Diagnostic

Thermal and fluid measurement parameters and tools, optics and laser basics, fluid flow measurement, thermal and combustion measurements, image capturing, flow and image processing.

MMJ 2443 Internal Combustion Engines

Engine Design and Operating Parameters, Thermo chemistry of fuel-air mixtures, Properties of Working Fluids, Ideal Models of Engine Cycles, Gas Exchange Process, Sl Engine Fuel Metering and Manifold Phenomena, Combustion in Spark-and Compression-Ignition Engines, Pollutant formation and Control.

APPLIED MECHANICS

MMJ 1133 Fatigue and Fracture Mechanics

Fatigue of Engineering Materials, Fretting, Mechanics of Sharply Cracked Bodies, Linear Elastic Fracture Mechanics (LEFM), Non-linear Fracture Mechanics (NFM), Fatigue Crack Propagation, Fracture Mechanics of Composites.

MMJ 1153 Computational Methods in Solid Mechanics

Introduction to computational methods in engineering, basic concepts in engineering analysis, formulation of finite element method, non-linear analysis in solid and structural mechanics, computer procedures for finite element analysis.

MMJ 1163 Advanced Engineering Materials

Introduction to engineering materials, application of engineering materials, materials for specific applications, metallography, techniques of failure analysis, fatigue failure, creep failure, corrosion degradation, methods of material selection, selection of materials for specific applications.

MMJ 1183 Elasticity

Stress vector concept, equilibrium, stress tensor concept, principal axes and stresses, principal shearing strains, octahedral shear stress, stress deviator, kinematics of deformable solid, small strain and linear strain, Hooke's law and elasticity tensor, isotropy, physical interpretation of elastic constants, formulation of exact solution to some linear elasticity problems.

MMJ 2123 Plates, Shell and Pressure Vessels

Stress and deflection analysis of structural plates and membranes under mechanical and thermal loads; variational and numerical methods; instability and vibrations; membrane shell theory; cylindrical shells; pressure vessel and piping design applications; ASME Pressure Vessel Code.

MMJ 2143 Advanced Mechanics of Composite Materials

Classification of composite materials, material development for advanced technology, lamina analysis, laminates analysis, failure analysis, sandwich structures, impact mechanics of composite materials.

MMJ 2153 Structural Reliability

Introduction to reliability engineering, functions of random variables, statistical models used in engineering analysis and design, reliability predictions and modelling, structural loads and resistance, simulation techniques, structural safety analysis, system reliability, bounds on system reliability, variance reduction techniques, first and second order reliability methods.

SYSTEMS & CONTROL

MMJ 1233 Acoustics

Theory of acoustics, introduction to the propagation of acoustic disturbances, one-dimensional acoustic wave motion, waves in three-dimension, sound in enclosures, sound radiation, enclosed sound fields, sound in ducts.

MMJ 1243 System Modelling and Simulation

The essence of modelling and simulation of dynamical systems, computer models versus physical models, types of mathematical models, verification and validation and establishing credibility of models, modelling and simulation design tools, modelling and simulation stages, modelling and simulation software, practical applications and case studies.

MMJ 1253 Advanced Industrial Automation

Automation components, industrial pneumatics, industrial hydraulics, industrial sequences control system and application, programmable logic controller and microprocessor-based control, Computer Integrated Manufacturing (CIM), class projects.

MMJ 1283 Vibration Control and Instrumentation

The course addresses the physical principles and related adaptive signal processing techniques to achieve the control of sound fields and structural vibrations. Topics covered include: propagation in ducts, minimization of radiation using source coupling, sound field control in enclosures, vibration control of lumped element and distributed parameters structures, structural control to minimize acoustic radiation, feedback and feedforward control theory, stability analysis, LMS based algorithms, hardware for control implementation.

MMJ 1293 Structural Dynamics

Vibration of Plates, Longitudinal, shear and flexural wave equations, Natural modes and frequencies of finite beams, bars, and torsion members, Effects of different boundary conditions, Mechanical Impedance and Mobility, Impedance and mobility of systems, Mobility approach to structural analysis and vibration Isolation, Approximation Methods of Calculating Modes and Natural Frequencies.

MMJ 2213 Adaptive and Intelligent Control System

Theory and analysis of control system using modern control techniques, intelligent methods for dynamic system design., Control System Design, State Space Model, Linear Observer, Neural Network Models, Fuzzy System, Genetic Algorithm.

MMJ 2243 Robot System and Control

Introduction to robot system, Kinematics, Statics and Dynamics of Robot, Robot Control, Practical Applications & Case Studies.

MMJ 2253 Advanced Control Engineering

Topics of current interest in control system theory for advanced graduate students with adequate preparation in linear and nonlinear system theory.

MMJ 2283 Mechatronic System Design

Introduction to mechatronics and applications, mechatronic design and method, mechatronic design process, artificial intelligence (AI) and adaptive elements in mechatronic system, practical applications and case studies.

MMJ 2293 Vehicle Dynamics and Control

Longitudinal vehicle control, engine dynamics, lateral vehicle control, automotive suspensions, tire models.

Engineering Design & Computer-Aided Design (CAD)

MMJ 1543 Computer-Aided Design and Applications

Overview of graphics technology and hardware, the mathematics behind Computer-Aided Design (CAD), viewing operations, visual realism, curves, surfaces, solid modelling, engineering applications, emerging technology and advanced application of CAD.

MMJ 1553 Optimisation in Engineering Design

Introduction to optimisation theory, formulation of optimisation problems, iterative optimisation approach, existence and uniqueness of an optimum solution, function of a single variable, unconstrained functions of several variables, sequentially unconstrained minimization techniques, constrained function minimization, special topics.

MMJ 2543 Graphics in CAD

Graphics systems and models, introduction to graphics programming, input and interaction, geometric objects and transformations, viewing, shading, graphics implementation —modelling, geometric processing, rasterisation, display, working with models, curves and surfaces.

MMJ 2553 Virtual Reality Programming for Engineers

Fundamental concept of Virtual Reality (VR), enabling technologies of VR, applications, human factors and human perception, computer graphics and geometric modelling principles of VR, modelling of virtual environments, existing tools, special topics.