Department of Engineering Mathematics and Physics

The department of Engineering Mathematics and Physics offers the following programs:

1. Master Degrees

1.1 Master of Engineering in Engineering Mathematics

The student must pass 30 credit hours in the form of courses and an additional 3 credit hours in the form of a scientific report.
The student must choose his courses from the list of courses that are specified as "Master courses" in **Engineering Mathematics**. The department council determines the specialization according to the courses that the student selects. The student is allowed to choose 2 courses from another major.

1.2 Master of Engineering in Engineering Physics

The student must pass 30 credit hours in the form of courses and an additional 3 credit hours in the form of a scientific report.
The student must choose his courses from the list of courses that are specified as "Master courses" in **Engineering Physics**. The department council determines the specialization according to the courses that the student selects. The student is allowed to choose 2 courses from another major.

1.3 Master of Science in Engineering Mathematics

The student must pass 24 credit hours in the form of courses and an additional 8 credit hours in the form of a thesis.
The student must choose his courses from the list of courses that are specified as "Master courses" in **Engineering Mathematics**. The department council determines the specialization according to the courses that the student selects. The student is allowed to choose 2 courses from another major.

1.4 Master of Science in Engineering Physics

The student must pass 24 credit hours in the form of courses and an additional 8 credit hours in the form of a thesis.
The student must choose his courses from the list of courses that are specified as "Master courses" in **Engineering Physics**. The department council determines the specialization according to the courses that the student selects. The student is allowed to choose 2 courses from another major.

3. Doctor of Philosophy- Ph.D. Degree

3.1 Doctor of Philosophy in Engineering Mathematics

The student must pass 18 credit hours in the form of courses and an additional 24 credit hours in the form of a dissertation.
The student must choose his courses from the list of courses that are specified as "Ph.D. courses" in **Engineering Mathematics**. The department council determines the specialization according to the courses that the student selects. The student is allowed to choose 3 courses from another major.

3.1 Doctor of Philosophy in Engineering Physics

The student must complete 18 credit hours in the form of courses and an additional 24 credit hours in the form of a dissertation.
The student must choose his courses from the list of courses that are specified as "Ph.D. courses" in **Engineering Physics**. The department council determines the specialization according to the courses that the student selects. The student is allowed to choose 3 courses from another major.

List of Diploma, Master and Ph.D. courses

No.	Course Code	Course Name	Credit hours	Exam Duration	Prerequisites
1	07 19 711	Mathematical Analysis	3	3	
2	07 19 712	Linear Algebra	3	3	
3	07 19 713	Numerical Analysis	3	3	
4	07 19 714	Probability and Statistics	3	3	
5	07 19 715	Functional Analysis	3	3	

No.	Course Code	Course Name	Credit hours	Exam Duration	Prerequisites
6	07 19 716	Ordinary Differential Equations	3	3	
7	07 19 717	Analytical Mechanics	3	3	
8	07 19 718	Special Topics in Engineering Mathematics	3	3	
9	07 19 719	Partial Differential Equations	3	3	
10	07 19 720	Perturbation and Asymptotic Methods	3	3	
11	07 19 721	Numerical Solution of Partial Differential Equations	3	3	
12	07 19 722	Topology and Graph Theory	3	3	
13	07 19 723	Special Topics in Engineering Mechanics	3	3	
14	07 19 724	Fluid Mechanics	3	3	
15	07 19 725	Structural Dynamics	3	3	
16	07 19 726	Robot Dynamics	3	3	
17	07 19 727	Special Topics in Engineering Physics	3	3	
18	07 19 731	Mathematical Physics	3	3	

No.	Course Code	Course Name	Credit hours	Exam Duration	Prerequisites
19	07 19 732	Statistical Thermodynamics	3	3	
20	07 19 733	Quantum Physics	3	3	
21	07 19 734	Solid State Physics	3	3	
22	07 19 735	Atomic and Nuclear Physics	3	3	
23	07 19 736	Electromagnetic Wave Theory	3	3	
24	07 19 737	Applied Optics	3	3	
25	07 19 738	Lasers and their Applications	3	3	
26	07 19 740	Special Topics in Engineering Geometry	3	3	
27	07 19 741	Differential Geometry	3	3	
28	07 19 742	Foundation of Statistics	3	3	
29	07 19 743	Mathematical Modeling	3	3	
30	07 19 744	The Boundary Element Method	3	3	
31	07 19 745	Quantum Mechanics	3	3	

No.	Course Code	Course Name	Credit hours	Exam Duration	Prerequisites
32	07 19 746	Hydrogen Energy Technologies	3	3	
33	07 19 747	Regression Analysis and Design of Experiments	3	3	
34	07 19 748	Simulation of Stochastic Systems	3	3	
35	07 19 749	Queuing Theory	3	3	
36	07 19 811	Advanced Ordinary Differential Equations	3	3	
37	07 19 812	Optimization Theory and Techniques	3	3	
38	07 19 813	Advanced Perturbation and Asymptotic Techniques	3	3	
39	07 19 814	The Finite Element Method	3	3	
40	07 19 821	Solid Mechanics	3	3	
41	07 19 822	Dynamics of Space Flight	3	3	
42	07 19 823	Advanced Analytical Mechanics	3	3	
43	07 19 824	Advanced Dynamics of Rigid Bodies	3	3	
44	07 19 825	Wave Propagation in Continuous Media	3	3	

No.	Course Code	Course Name	Credit hours	Exam Duration	Prerequisites
45	07 19 826	Nonlinear Systems	3	3	
46	07 19 831	Solid State Electronics	3	3	
47	07 19 832	Acoustics	3	3	
48	07 19 833	Electrodynamics	3	3	
49	07 19 834	Quantum Theory of Solids	3	3	
50	07 19 841	Computer Aided Geometric Design	3	3	
51	07 19 851	Stochastic Processes	3	3	
52	07 19 861	Mathematical Modeling and System Identification	3	3	
53	07 19 701	M.Eng. Scientific Report in Engineering Mathematics	3	Defense	
54	07 19 702	M.Eng. Scientific Report in Engineering Physics	3	Defense	
55	07 19 705	M.Sc. Thesis in Engineering Mathematics	8	Defense	
56	07 19 706	M.Sc. Thesis in Engineering Physics	8	Defense	
57	07 19 801	Ph.D. Dissertation in Engineering Mathematics	24	Defense	

No.	Course Code	Course Name	Credit hours	Exam Duration	Prerequisites
58	07 19 802	Ph.D. Dissertation in Engineering Physics	24	Defense	

Description of Courses for Graduate Programs (Master- Doctor of Philosophy)

07 19 711 Mathematical Analysis
Boolean algebra. mapping. Denumerable sets. Real numbers: Axioms. Ordering. Tietze Urysohn extension theorem. Metric spaces: fundamentals. Continuous mapping. Limits. Cauchy sequences. Compactness. Space of continuous functions: Derivatives. Formal rules of derivation. Sets and functions. Axioms for the real numbers. Suprema and infima and the axioms of bounds. Real sequence. Real series. Hilbert spaces. Differential calculus. Integration.

07 19 712 Linear Algebra
Linear vector spaces. Basis. Linear dependence and independence. Linear transformation. Eigenvalues and eigenvectors. Positive definite matrices. Linear programming.

07 19 713 Numerical Analysis
Solutions of algebraic equations. Interpolation. Numerical integration and differentiation. Numerical solution of ordinary differential equations. Approximation theory. Error analysis. Computer applications.

07 19 714 Probability and Statistics
Concepts of probability. Conditional expectations. Independence. Laws of large numbers. Probability models and distributions. Introduction to stochastic processes theory. Sampling. Theory of estimation.

07 19 715 Functional Analysis
Normed spaces. Banach spaces. Seperability. Arzela-Ascoli theorem. Ston-Weierstrass theorem. Hahn Banach theorem. Dual spaces. Riesz representation theorem. Hilbert spaces.

07 19 716 Ordinary Differential Equations
Existence and uniqueness. Linear systems. Analytic systems. Autonomous systems. Stability theory. Sturm-Liouville theory. Introduction to partial differential equations.

07 19 717 Analytical Mechanics
Types of Dynamical systems. Constraints and its classification. Degree of freedom. Generalized coordinates. Lagrange Multipliers. Lagrange Equation of the first type. Kinetic Energy of a Dynamical System. Potential Energy. Virtual Work. Generalized Forces. Lagrange's Equation of Motion of a Holonomic Dynamical system. Energy Change Theorem. Energy Equation for a Conservative Holonomic Dynamical System. Hamilton's Function. Hamilton Equations. Canonical Transformations. Hamilton-Jacobi Equations. Poisson's Brackets. Routh Function. Routh Equations of motion. Ignorable (Cyclic) Coordinates in the Equations of Motion At Lagrange ,Hamilton ,and Routh.

07 19 718 Special Topics in Engineering Mathematics
This course is studied through specialized and advanced topics covering: Advanced topics in mathematical analysis and applications, advanced topics in Algebra and applications, advanced topics in probability and statistics and application.

07 19 719 Partial Differential Equations
Diffusion equations for nonuniform media. Solution of the nonhomogeneous equation subjected to time dependent boundary conditions both in Cartesian as well as other coordinate systems. The Laplace and Poisson equations. Applications of complex variables technique. Green’s function for time independent and time dependent problems. The method of characteristics for the wave equation and propagation of discontinuities. Introduction to the application of integral transforms.

07 19 720 Perturbation and Asymptotic Methods
Exposition of various methods. Regular perturbation theory. Singular perturbation theory. Initial and boundary layers. Method of multiple scales. Ray theory. Two times methods. Application problems.

07 19 721 Numerical Solution of Partial Differential Equations
Fundamentals of the finite difference method. Implementation to the diffusion, wave and Poisson equations. Discussion of stability, consistency and convergence of the methods presented. The method of characteristics for hyperbolic equations. Examples.

07 19 722 Topology and Graph Theory
Introductory general topology. Graph theory: Definitions. Isomorphic graphs. Connectivity. Optimization. Planarity and coloring. Trees. Routed tress. Binary tress. Applications.

07 19 723 Special Topics in Engineering Mechanics
This course is studied through specialized and advanced topics covering: Advanced topics in Engineering Mechanics and applications.

07 19 724 Fluid Mechanics
Introduction. Equations of motion. Continuity _Momentum Equations. Bernoulli's Energy Equation. Theory of Impulse. Two Dimensional Motion. Connection with the Energy Equation. Theory of complex variables. Conformal transformations. Surface Waves. Viscosity.

07 19 725 Structural Dynamics
Free and forced vibration of single-degree-of-freedom, multiple-degree-of-freedom, and continuous systems. Vibration of continuous systems; Modal Analysis.

07 19 726 Robot Dynamics
Homogeneous transformation, Forward kinematics using Denavit-Hartenberg notation, Multiple solutions of inverse kinematics, Singularity and Redundancy, Workspace considerations, Differential motion and velocities, Derivation of the equations of motion using Lagrange Equation and Hamilton's Principle, Planning paths using the dynamic model, Force analysis and transformation of forces and moments between coordinate frames, Independent joint control of manipulators

07 19 727 Special Topics in Engineering Physics
This course is studied through specialized and advanced topics covering: Advanced topics in Engineering Physics and application.

07 19 731 Mathematical Physics
Basic principles. Modeling: vibrating string. One-dimensional wave equation. Separation of variables. D'Alembert solution for the wave equation. One-dimensional heat flow. Heat flow through an infinite rod. Modeling: vibrating film. Two-dimensional wave equation. Bessel equation. Properties of the Laplace transform. Properties of the Fourier transform. Fourier transform of the convolution.

07 19 732 Statistical Thermodynamics
Introducing the statistical methods. Statistical description of a particle system. Statistical thermodynamics. Maxwell-Boltzmann distribution. Simple applications of statistical thermodynamics. Bose-Einestein and Fermi-Dirac distributions. Applications: Law of mass action; transport phenomena.

07 19 733 Quantum Physics
Special theory of relativity. Duality: particle properties of waves; wave properties of particles. Atomic spectra and atomic structure. Elementary quantum mechanics. Quantum theory of the hydrogen atom. Atoms with multiple electrons. Molecules. Atomic reactions.

07 19 734 Solid State Physics
Crystal structure. Diffraction of waves by crystals. Reciprocal lattice. Elastic constants and elastic moduli. Crystal binding. Phonons: lattice vibrations; thermal properties. Dielectrics. Fermi energy of a multi-electron system. Electrical conductivity at high frequencies. Plasmons. Binding energy. Thermoionic emission. Energy bands. Semiconductor crystals. Fermi surfaces. Metals.

07 19 735 Atomic and Nuclear Physics
Atomic structure. Thomson's model of the atom. Rutherford's theory of α-particles scattering. The Special theory of relativity: Michelson-Morley experiment. The Compton effect. The hydrogen atom. Multi-electron atoms. Isotopes. α-decay. β-decay. γ rays and γ-decay. Elementary particles. Nuclear reactions. Nuclear forces and nuclear structure.

07 19 736 Electromagnetic Wave Theory
Vector analysis. Electrostatics. Boundary conditions in electrostatics. Multiple poles. Dielectrics. Magnetostatics. The magnetic field due to a steady current in free-space. The magnetic field in the presence of matter. Electromagnetic induction. Magnetic energy method of solving field problems subjected to certain boundary conditions.

07 19 737 Applied Optics
Electromagnetic waves. Interference. Fraunhofer and Fresnel diffraction. Polarization. Laser. Resonators. Optical waveguides. Optical fibers. Introducing nonlinear optics. Fourier optics. Holographs.

07 19 738 Lasers and their Applications
Atomic structure. Atomic quantized transitions. Stimulated emission and amplification. The rate equation. Saturation. Q switching. Coherent optical oscillations. Laser oscillation. Dynamic and transient effects. Confinement. Mode locking. Frequency modulation. Nonlinear lasers. Applications: medical; industrial; in the communication field.

07 19 740 Special Topics in Engineering Geometry
This course is studied through specialized and advanced topics covering: Projective geometry. Central projection. Stereographic projection. Gonomonic projection. Map projection. Four dimensional descriptive geometry. Kinematic geometry.

07 19 741 Differential Geometry
Representation of planes. Representation of space curves. Curvature and osculating plane. Torsion. Involute and evolute. Representation of surfaces and characteristics. Mapping of different types.

07 19 742 Foundation of Statistics
Sampling distributions. Point and interval estimations. Properties of estimators. Testing statistical hypothesis. Types of errors. Linear and multiple variance.

07 19 743 Mathematical Modeling
Mathematical modeling: an introduction, discrete models, continuous models, probabilistic models, optimization models, applications and investigating some cases.

07 19 744 The Boundary Element Method
The Green's theorem and Green's identities. Boundary integral formulation of differential equations. Boundary elements and applications to steady and time dependent problems. Computational aspects of the method.

07 19 745 Quantum Mechanics
Schrödinger equation and its solution. Continuous and discrete spectra of Schrödinger equation. Approximate methods to solve Schrödinger equation. Statistical interpretation of quantum mechanics. Harmonic linear oscillator. Perturbation theory. Quantum theory of radiation. General theory for the motion of a particle in a uniform central field. Solving simple problems in spherical coordinates. The hydrogen atom in an electric field. Particle scattering by a central force. The atom in a magnetic field.

07 19 746 Hydrogen Energy Technologies
Physical and chemical properties of hydrogen. Hydrogen production technologies from: fossil fuels; biomass; water. Energy storage: gaseous storage; liquid storage; metal hydrides. Hydrogen conversion technologies. Applications.

07 19 747 Regression Analysis and Design of Experiments
Linear regression. Test of lack of fit. Multiple regression using matrix approach. Nonlinear regression. Completely randomized designs. Randomized complete blocks. Latin square. Factorial and incomplete blocks.

07 19 748 Simulation of Stochastic Systems
Generating random numbers. Generating discrete random variables. Generating continuous random variables. Discrete event simulation. Statistical analysis of simulation outputs. Applications.

07 19 749 Queuing Theory
Description and performance evaluation of queueing systems. Relevant stochastic processes. Elementary queueing systems. Markovian and non-Markovian queueing systems. Networks of queues.

07 19 750 Computational Methods for Digital Image Processing
This course introduces the mathematical formalism for describing imaging systems, with emphasis on systems whose response has been constrained to be linear in dynamic range and which also does not depend on spatial location in the scene. Specifically, it provides mathematical foundations and computational methods for digital manipulation of images; image acquisition ; image segmentation; image projections and rectification; image statistics and point processing; linear and nonlinear image filters; Fourier domain processing; compression and applications of partial differential equations, calculus of variations and differential geometry in digital image processing.

07 19 751 Computational Geometry
Introduction to differential geometry of curves and surfaces. Offset of curves. Offset of surfaces. Algorithms: intersection of line segments. Convex hull. Closest pair of points.

07 19 752 Mathematics of 3D graphics
Coordinate systems. Vector algebra. Affine and projective geometry. Matrices and geometric transformation. Numerical linear algebra and equation solving. Differential geometry. Interpolation and approximation. Modeling of curves and surfaces: splines.

07 19 753 Introduction to Geodesy and Map Projection
Spherical trigonometry, geodetic co-ordinate systems, satellite orbits computations, map projections of the spherical earth.

07 19 754 Operations Research
Linear programming and sensitivity analysis (graphical method and algebraic method) – integer programming (branch-and-bound technique, cutting plane method) – game theory – simple queueing models – inventory models – applications.

07 19 755 Number Theory
Abstract structures (groups, rings and fields, finite fields, field extensions) - modular arithmetic – Fermat's law - Special congruences – Chinese remainder theorem - quadratic residues and quadratic reciprocity – index calculus - elliptic curves – applications in public key cryptography and symbolic computations.

07 19 756 Cryptology

Introduction to the field – Symmetric key cryptosystems and their cryptanalysis: Stream Ciphers and Block ciphers – Block ciphers examples: Caesar Substitution Cipher, Hill cipher, Data encryption standard (DES), Advanced Encryption Standard – Hashing algorithms - Public key cryptosystems and various primitives: Encryption, Digital Signatures, Signcryption, Key agreement – Attacks on well-known hard computational/ decisional problems.

07 19 757 Calculus of Variations

Introduction - The method of variations in problems with fixed boundaries-Variational problems with moving boundaries and certain other problems-Sufficient conditions for an extremum-Variational problems involving a conditional extremum- Direct methods in Variational problems

07 19 758 Computational Matrix Algebra

Introduction-Matrices-Determinants and elementary matrices-Solutions of simultaneous equations: n equations in n variables-Gaussian elimination and computer arithmetic-Solutions of simultaneous equations: m equations in n variables-Vector spaces-Eigenvalue problems
-Numerical calculation of eigenvalues

07 19 759 Stochastic Modeling

Basic elements of stochastic modeling: sample paths, probability and statistics, simulation.
Arrival-counting process: a generic process, the Poisson process, the renewal arrival-counting process. Discrete-time processes: Markov chains, time-dependent and time-independent performance measures. Continuous-time processes: Markov processes, time-dependent and time-independent performance measures, semi-Markov processes. Queueing processes: standard notations, birth-death queues, Markovian queues, queueing networks.

07 19 760 Difference Equations

Factorial polynomials - Finite differences and difference operator- Elementary theory of summation-The determination of the difference equations- First order difference equations- Linear difference equations with constant coefficients- Linear difference equations with variable coefficients

07 19 761 Fourier series

Trigonometric Fourier series - Orthogonal system- Convergence of trigonometric Fourier series- Trigonometric series with decreasing coefficients- Operations on Fourier series

07 19 762 Applied Analysis (Inequalities and Summability)

PART (I): Inequalities

Basics- Functions- Holder and Minkowski's inequalities- Mean value inequality- Inequalities involving monotincity hypotheses- Examples on inequalities- Bernoulli's numbers and polynomials

PART (II): Summability

Theory of sequences and series- What is a series?- Definition of the sum of a series- Euler's transformation- Conservative and regularity theorems- Conservative and regularity theorems for matrix transformation between sequence spaces- Semi continuous transformations-Limitation theorems -Inclusion and equivalence theorems

07 19 763 Integral Equations

Classification of Integral Equations. Definitions.- Some important identities.- Relationship between linear differential equations and Volterra integral equations.- Special types of kernels- Nonlinear integral equations. Integral Equations of the Convolution Type-Integral transforms- The Laplace transforms.- The Fourier transforms.- Volterra integral equation of the first kind- Volterra integral equation of the first kind with logarithmic kernel.- Abel's problem: Abel's integral equation and its generalization. Method of Successive approximations (Neumann series - Iterates and resolvent kernel - Degenerate kernels - Nonhomogenous). Fredholm equations with degenerate kernel.- Approximating a kernel by a degenerate one- Collocation method).

07 19 764 Nonlinear Ordinary differential Equations

Introduction -The method of slowly varying amplitude and phase. Jacobian elliptic functions - Hyper geometric functions - Elliptic functions - Differentiation of Jacobian elliptic functions - Elliptic Integrals.

07 19 765 Nanomaterials

Introduction to Nanoscience, zero/one/ two/ three-Dimensional Nanostructures, Special Nanomaterials, Nanostructures Fabricated by Physical Techniques, Characterizationof Nanomaterials, Some Applications of Nanomaterials.

07 19 766 Physical Optics

Geometrical Optics, Mathematics of light as a wave, Electromagnetic Theory, Propagation of Light , Superposition of Waves, Polarization, Interference, Diffraction.

07 19 767 Optical WDM systems

Optical systems, WDM concepts and components, WDM multiplexers, Tunable optical filters, Fiber Bragg Grating, Applications.

07 19 768 Basics of Nanotechnology
Introduction to Nanotechnology, Fabrication of Nanostructures, Optical/ electricaland Imaging Characterization of Nanostructures, Some Related Applications.

07 19 769 Solar Cells
Basics of semiconductor junctions, Introduction to photovoltaic cells, Materials properties and Physics of devices, Heterojunction solar cells, Dye-sensitized solar cells, Organic solar cells.

07 19 770 Quantum and Optoelectronic Devices
Introduction to optoelectronic devices,, The rise of III-nitrides, The evolution of nitride semiconductors, III-nitrides light emitting sources and photo-detectors, Radiative and non-radiative recombination, Electrical and optical properties of LEDs, Basic principles of semiconductor optical amplifiers, Structures and materials of semiconductor optical amplifiers.

07 19 771 Fuel Cell Systems and Technologies
The principles of electrochemistry, and thermodynamics, kinetics, and heat and charge transport as it relates to fuel cells- Fuel cell types and physical/chemical/technical characteristics - Main fuel cell components. Influence of the various operational parameters on fuel cell performance . Stack design - Thermal and water management – Fuel cell applications.

07 19 772 Material Science
Introduction - Classification of Material - Atomic Structure, and Electronic Configuration - Crystal Geometry, Structure and Defects- Bonds in Solids - Nanostructured Materials

07 19 773 Plasma Energy
Introduction – Properties and parameters – Complex plasma phenomena – Mathematical descriptions – Artificial plasma – Examples of industrial / commercial plasma – Plasma energy storage – Applications of plasma – Plasma sources.

07 19 774 Time Series and Applications
Fundamental of time series analysis. Linear stochastic Models. Stationary and Nonstationary Stochastic Models .Autocorrelation and spectral analysis. Linear Stationary Models: Autoregressive Processes (AR), Moving-Average Processes (MA), Mixed Autoregressive-Moving Average Processes (ARMA), Linear Nonstationary Models : Autoregressive Integrated Moving Average process (ARIMA). Applications. Using the Simulink Toolbox to Simulate the Linear stochastic models.

07 19 811 Advanced Ordinary Differential Equations

Qualitative theory of ordinary differential equations. Existence and uniqueness of solutions. Stability theory. Periodic solutions. Limit cycles. Applications to theory of oscillations.

07 19 812 Optimization Theory and Techniques
Unconstrained optimization. Nonlinear programming. Non-differential optimization. Applications.

07 19 813 Advanced Perturbation and Asymptotic Techniques
Introduction. Parameter Perturbations. Coordinate Perturbations. Order Symbols and Gauge Functions. Asymptotic Expansions and Sequences. Nonuniform Expansions. Straight forward Expansions and Sources of Nonuniformity. The Method of Strained Coordinates. The Method of Matched and Composite Asymptotic Expansions. Variation of Parameters and Methods of Averaging. Method of Multiple Scales. Asymptotic Solutions of Linear Equations. Applications in the Solutions of Autonomous and non autonomous Dynamical Systems. Boundary and Initial Value Problems

07 19 814 The Finite Element Method
Variation methods. Rayleigh Ritz and Galerkin formulation. The Finite Element idealization. Applications. Higher order elements and isoparametric elements. Higher degrees of freedom and curved sided elements. Discussion of convergence and error estimation. Computational aspects.

07 19 821 Solid Mechanics
Mathematical description of stress, deformation, and constitutive equations of solid mechanics; 3D stress state; plane stress problem; plane strain case; plane deformation case. Virtual work theorem for plane stress problem. Finite element formulation

07 19 822 Dynamics of Space Flight
Elements of the theory of Newtonian potential. The two-body problem. Duration of flight of the satellite between two points of an orbit. The trajectory of satellite in 3-dimensional space. The n-body problem. The application of the concept of the sphere of action in the approximate calculation of the trajectory of a small body. The limited problem of three bodies.

07 19 823 Advanced Analytical Mechanics
Basic Definitions. Two and three Dimensional Kinematics of a rigid body. Basic concepts. Theory of finite rotations of a rigid body. Principal Dynamical Quantities. The work and Potential Energy. General equation of Dynamics. Analytical Statics. Lagrange Differential Equations. Different Forms for the differential Equations of motion.

Dynamics of Relative Motion. Canonical Equations and Jacobi theorem. The Variation principles of Mechanics.

07 19 824 Advanced Dynamics of Rigid Bodies

Euler-Poison Equations. Integration by Series. Elliptic Functions. Integrable Canonical Systems. The integrable cases of Euler-Poisson Equations. The unique solutions, Analytical and algebraic integrals of Euler-Poison Equations. The motion of a rigid body in Newtonian Force Field. Dynamic stability; continuous systems

07 19 825 Wave Propagation in Continuous Media

Transverse waves on strings and membranes; longitudinal, torsional, and flexural waves in rods; compression, shear, and surface waves in elastic half-spaces; water waves: Shallow Water Waves, Deep Water, and Gravity Waves.

07 19 826 Nonlinear Systems

Introduction. Fundamental Concepts in The Theory of Stability. Autonomous Systems of Single Degree of Freedom. Phase Plane Plots. Conservative Systems. Routh-Hurwitz Criterion. Motion in the Large. Limit Cycles. Liapunov's Direct Method. Secular Terms. Lindstetd –Poincaré Method. Van der Pol's Equation. Forced Oscillations. Jump Phenomenon. Sub harmonic and Combinations Harmonics. Systems with Time dependent coefficients. Chaos.

07 19 831 Solid State Electronics

Electronic energy bands. Semiconductor crystals. Superconductivity. Dielectric properties. Ferroelectric crystals. Diamagnetism, paramagnetism and ferromagnetism.

07 19 832 Acoustics

Basics of oscillatory motion. Longitudinal waves. The vibrating string. Vibrating rods. Two-dimensional wave equation. Sound wave equation and its simple solution. Reflection and transmission. Absorption and attenuation of sound waves in fluids. Transmitting and receiving sound waves.

07 19 833 Electrodynamics

Time-dependent fields. Maxwell’s equations. Conservation of energy and momentum. Planar electromagnetic waves. Wave propagation. Simple radiating systems. Scattering and diffraction. Magnetohydrodynamics and the plasma physics. Dynamics of relativistic particles. Radiation by moving charges. Multipole fields. Electromagnetic properties of superconductors.

07 19 834 Quantum Theory of Solids

Excitation and exciters in solids: the electron; the phonon; the plasmon; the polariton; the polaron; the exciton. Polarization of waves. Fermion fields and Hartree-Fock approximation. Many-body techniques. Electron-phonon interactions. Superconductivity. Energy bands. Crystal symmetry. Fermi Surfaces. Semiconductor crystals. Alloys. Defects.

07 19 841 Computer Aided Geometric Design

Interpolation techniques for the curve Representation: B- Spline Representation, Smooth curve, Uniform Subdivision, Four Point Scheme Tensor Products, Tensor Product-Bezier surfaces- Surfaces of Arbitrary Topology. Bezier Techniques for the Representation of Triangular Patches. Interpolation for Surfaces. Constructing the smooth surfaces- GK Construction.

07 19 842 Computational Geometry for Design

Curves and surfaces design. Composite curves and splines. Composite surfaces. Cross-sectional design. Computing methods for surfaces design.

07 19 843 Advanced Topics in Engineering Geometry

Topics to be selected by the instructors.

07 19 844 Multi-dimensional Geometry

Linear space. Linear transformations of variables. Planes in affine space. Linear, bilinear and quadratic forms. Spaces with quadratic metric. Multi-vectors and other forms. Quadratic hyper-surfaces. Projective space.

07 19 845 Mathematic of Geodesy and Map projection

Spherical and ellipsoidal datum of the earth, geodetic co-ordinate computations in ellipsoidal and rectangular spatial co-ordinate systems, astronomical co-ordinates, co-ordinate system transformations, Gaussian and Riemannian surface theories, map projection computations.

07 19 851 Stochastic Processes

A systematic account of several principal areas in stochastic processes; branching processes. Markov chains (discrete and continuous parameter). Poisson processes. Gaussian processes. Brownian motion.

07 19 852 Random Signals and Systems

Linear and nonlinear system. Continuous and Discrete systems. The response of systems to Linear stochastic signals. Using Matlab to get the response of systems to linear stochastic signals .Gaussian processes. Stationary processes (discrete and continuous

type). Nonstationary continuous time process. Linear systems in conjunction with memory less nonlinear devices. Markov principles. . Monte Carlo simulation.

Note: Prerequisites to study 0719877 the course of Mathematical Modelling 0719743

07 19 853 Applications of system Identification Methods

The main purpose of this course is the applications of system identification methods Presented at the toolbox 'Ident' of Matlab to systems from input and output Data.
Linear Least Squares and Normal Theory. Maximum Likelihood Estimators. Models for Dynamic Systems. Estimation for Dynamic Systems. Recursive Algorithms.

Note: Prerequisites to study 0719878 the course of Mathematical Modelling 0719743

07 19 861 Mathematical Modeling and System Identification

Mathematical theories and foundations of modeling and identification techniques of systems. Applications, analysis of some selected models.

07 19 862 Fuzzy logic

Fuzzy sets – Operations on Fuzzy Sets – Linguistic variables – Fuzzy relations and operations on fuzzy relations – Fuzzy inference rules – Fuzzy logic system – Possibility theory – Applications in control systems and reliability

07 19 863 Advanced Topics in Cryptology

Review of basics of cryptography – Blind signatures – Group signatures – Proxy signatures -Trace and revoke schemes - Provable security – Quantum cryptography – Applications in communication systems and networks security

07 19 864 Advanced Queueing Systems

Networks of queues: reversibility, output theorem, tandem queues, partial balance, product-form distribution.-Matrix-analytic method: structured Markov models, matrix-geometric distribution, solution algorithms.-Queueing systems with special structures: retrial queues, queues with vacations, polling systems, discrete-time queues, applications to

07 19 865 Advanced Topics in Engineering Mathematics

Topics to be selected by the instructors.

07 19 866 Advanced Topics in Engineering Mechanics

Topics to be selected by the instructors.

07 19 867 Nonlinear Optics
Introduction to Nonlinear optics, Models of the NLO Response, Nonlinear Wave Equation,Quantum Theory of Nonlinear Optics, Applications.

07 19 868 Advanced Applications of Nanotechnology
General overview on nanomaterials, nanoscience and nanotechnology, nanosensors, nanomaterials in solar cells, nanotechnology in biomedical applications, applications of nanofibers.

07 19 869 Nano materials Fabrication and Characterization
Nanoparticles synthesis, Layer-by-Layer (LbL) self-assembly, E-beam evaporation, Spin coating, Focused ion beam (FIB), Atomic force microscopy (AFM) for nanografting and nanolithography, E-beam lithography, Electrospinning, Physical Vapor Deposition (PVD)., Chemical Vapor Deposition (CVD), Atomic Layer Deposition (ALD), Optical and imaging characterization techniques.

07 19 871 Advanced Hydrogen Energy Technology
Clean methods for hydrogen production - New materials and advanced technologies for the storage of hydrogen- Fuel cell system applications - -Development of Fuel Cell models - Development of a hydrogen infrastructure for the transportation sector - Hydrogen Economy, Hydrogen safety and Standards for hydrogen energy technologies

07 19 872 Advanced Topics in Engineering Physics
Topics to be selected by the instructors.

07 19 701 M. Eng. Scientific Report in Engineering Mathematics

07 19 702 M. Eng. Scientific Report in Engineering Physics

07 19 705 M. Sc. Thesis in Engineering Mathematics

07 19 706 M. Sc. Thesis in Engineering Physics

07 19 801 Ph. D. Dissertation in Engineering Mathematics

07 19 802 Ph. D. Dissertation in Engineering Physics