MT- 1810 LINEAR ALGEBRA

Category of the Course: MC Hrs/Week: 6
Year & Semester: I &I Credits: 4

Objectives:

To introduce the basic concepts and methods in the study of Linear Transformation on finite dimensional Vector spaces and their Matrix Forms.

Unit 1:

Characteristic values – Annihilating polynomials – Invariant subspaces – Simultaneous Triangulation; Simultaneous Diagonalization.

Unit 2:

Direct sum decompositions-Invariant direct sums-The Primary Decomposition theorem-Cyclic subspaces and Annihilators.

Unit 3:

Cyclic Decompositions and the Rational form-the Jordan form-Computation of invariant factors.

Unit 4:

Inner products- -Linear functionals and adjoints-Unitary operators-Normal operators. Forms on Inner product spaces-Positive forms.

Unit 5:

Bilinear forms-symmetric bilinear forms-skew-symmetric bilinear forms-Group preserving bilinear forms.

Text book:

Kenneth Hoffman & Ray Kunze, *Linear Algebra*, Prentice-Hall of India, 1975

[Chapter 6: Sections 6.2 to 6.8, Chapter 7: Sections 7.1 to 7.4, Chapter 8: Sections 8.3 to

8.5, Chapter 9: Sections 9.1 to 9.3, Chapter 10: Sections 10.1to 10.4]

References:

1. M.Artin, *Algebra,* Prentice Hall of India, 1991.
2. Ben Noble, James W. Daniel, *Applied Linear Algebra,* Prentice-Hall of India

MT – 1811 **REAL ANALYSIS**

Category of the Course: MC Hrs/Week: 6
Year & Semester: I & I Credits: 4

Objective:

- To give a systematic study of Riemann Stieltjes Integral and the calculus on R^n
- To brief study of convergence of sequences and series, Power series, Fourier series and Polynomials.

Unit I:

Riemann – Stieltjes Integral - Definition and properties of the Integral – Integration and Differentiation – Integration of vector valued functions.

Unit II:

Sequences and series of functions - Pointwise Convergence – Uniform Convergence –
Fourier series –Stone - Weierstrass Theorem.

Unit III:

Fourier series and Fourier Integral

Unit IV:

Function of several variables - Linear transformation – Differentiation – The Contraction
theorem – The Inverse Function theorem – The Implicit Function theorem

Unit V:

Discovering the Inverse Function Theorem - Algebraic Approach – Graphical Approach
– Implicit Formulas – More Variables – The Calculus Approach.
Discovering Real Analysis - Changes in Perspective – D' Alembert Wave equation for a
Vibrating string - D' Alembert Approach toward characterizing solutions of the I_D
Wave equation – Heat Flow and Heat Equation – Finding solutions to the Heat equation – Further Questions about Fourier's Heat equation and Fourier's series.

Text Book:

1. Walter Rudin, Principles of Mathematical Analysis, Third Edition, McGraw Hill, 1976.
   [Chapter 6: 6.1 – 6.27, Chapter 7: 7.1 – 7.27, Chapter 9: 9.1 – 9.29]
2. T. M. Apostol, Mathematical Analysis, Addison –
   Wesley, 1974. [Chapter 11: 11.1 – 11.15]
3. Terrance J. Quinn and Sanjay Rai, Pathways to Real Analysis, Narosa Publishing House,
   2009.
   [Chapter 1: 1.1 – 1.5, Chapter 3: 3.1 – 3.6]

MT- 1812 Ordinary Differential Equations

Category of the Course: MC Hrs/Week: 6
Year & Semester: I & I Credits: 4

Objective:

- To learn mathematical methods to solve Higher Order Differential Equations and apply to dynamical problems of practical interest.

Unit 1:

Linear Homogeneous and Non-Homogeneous Differential Equations – Basic Concepts – Initial and Boundary Value Problems – Linear Differential Equations of Higher Order – Linear dependence and Wronskian – Basic theory of linear equations – Method of Variation of Parameters – Two Useful formulae – Homogeneous Linear equations with Constant Coefficients.

Unit 2:

Method of Frobenius – Examples – Legendre's Equation and its Solutions – Generating Function for the Legendre Polynomials – Further Expressions for the Legendre Polynomials – Explicit Expressions – Special Values of the Legendre Polynomials – Orthogonality Properties of the Legendre Polynomials – Problems.

Unit 3:

Bessel's Equation and its Solutions – Generating Function for Bessel Functions – Integral Representations for Bessel Functions – Recurrence Relations – Definition of Hypergeometric functions – Properties – Examples.

Unit 4:

Existence and Uniqueness of Solutions: Lipschitz condition – Successive Approximation – Picard's theorem for Initial Value Problem – Linear Homogeneous BVP – Linear Non-homogeneous BVP – Strum-Liouville Problem – Green's functions – Non-existence of solutions – Picard's theorem for Boundary Value Problem.

Unit 5:

Stability of Nonlinear Systems: Stability of Quasi-linear systems – Stability of Autonomous Systems – Stability of non-autonomous systems – A Particular Lyapunav Function.

Text books:

1. S. G. Deo, V. Ragavendra, 'Ordinary Differential Equations and Stability Theory', Tata McGraw-Hill Publishing Company Ltd., 1980.
   [Chapter 1: Sections 2.1 – 2.6, Chapter 5: Sections 5.2 – 5.4, Chapter 7: Sections 7.1 – 7.5, Chapter 9: Sections 9.1 – 9.5]
2. W.W.Bell, 'Special functions for Scientists and Engineers', Dover Publications, 2004.
   [Chapter 1: Sections 1.1, 1.2, Chapter 3: Sections 3.1 – 3.5, Chapter 4 : Sections 4.1 – 4.4, Chapter 9: Sections 9.1 – 9.3]

References:

1. George F. Simmons, 'Differential Equations with Applications and Historical Notes', Tata McGraw-Hill Publishing Company Ltd., 1992.
2. George F. Simmons, Steven G Krantz, 'Differential Equations: Theory, Technique and Practice' Tata McGraw-Hill Publishing Company Ltd., 2007.
3. Earl A. Coddington, 'An Introduction to Ordinary Differential Equations', Prentice-Hall of India, New Delhi, 1992.
4. A. Chakrabarti, 'Elements of Ordinary Differential Equations and Special Functions', Wiley Eastern Ltd., 1990.
5. Boyce. W. E, Diprma. R. C, 'Elementary Differential Equations and Boundary Value Problems', John Wiley and Sons, NY, 2001.

MT – 1813 Differential Geometry

Category of the Course: MC Hrs/Week: 6
Year & Semester: I & I Credits: 4

Objectives:

- To teach some applications of abstract algebra and analysis to geometrical problems and facts.

Unit 1:

Curves – Analytical representation – Arc length, tangent – Osculating plane – Curvature – Formula of Frenet.

Unit 2:

Contact – Natural equations – General solution of the natural equations – Helics – Evolutes and Involutes.

Unit 3:

Elementary theory of Surfaces – Analytic representation – First Fundamental form – Normal, Tangent plane – Developable Surfaces.

Unit 4:

Second Fundamental form – Meusnier Theorem – Euler's Theorem – Dupin's Indicatrix – Some surfaces – Geodesics – Some simple problems.

Unit 5:

Equations of Gauss and Weingarten – Some applications of Gauss and the Coddazi equations – The Fundamental Theorem of Surface Thoery.

Text book:

Dirk J. Struik, *Lectures on Classical Differential Geometry*, Second Edition, Addison Wesley Publishing Company, London, 1961.

[Chapters: 1.1 – 1.11, 2.1 – 2.8, 3.1 – 3.6]

References:

1. Willmore, *An Introduction to Differential Geometry*, Oxford University Press, London, 1972.
2. Thorpe, *Elementary Topics in Differential Geometry*, Second Edition, Springer Verlag, New York, 1985.

3. Mittal, Agarwal, *Differential Geometry*, Thirtieth Edition, Krishna Prakashan, Meerut, 2003.
4. Somasundaram, *Differential Geometry*, Narosa, Chennai, 2005.
5. Venkatachalapthy, *Differential Geometry*, Margam Publications, Chennai, 2007.

MT -1815 Probability Theory and Stochastic Processes

Category of the Course: MC — Hrs/Week: 6

Year & Semester: I & I — Credits: 4

Objective:

- To provide basics of probability theory with applications in stochastic processes.

Unit – 1:

Probability – Basic theorems on Probability – Discrete Probability – Conditional Probability – Independent events – Baye's theorem – Random variables – Distribution function – Expectation and moments – Moment generating functions – Characteristic functions.

Unit – 2:

Standard discrete and continuous Univariate distributions - Marginal- Joint - Conditional distribution – Correlation..

Unit – 3:

Modes of Convergence- Markov - Chebyshev's and Jensen inequalities- Weak and strong law of large numbers – Kolmogrov's Inequality- Central limit theorem – Asymptotic distributions.

Unit – 4:

Methods of estimation- UMVU estimators- Maximum likelihood estimators- Properties of estimators- Confidence intervals- Testing of hypothesis: Standard parametric tests based on normal, χ^2, t, F distributions- Interval estimation.

Unit – 5:

Markov chains with finite and countable state space – Classification of states- limiting behavior of n- step transition probabilities- Stationary distribution- Poisson process and its properties – Pure birth process – Birth and death process.

Text Books:

1. Ross.S.M(2007), Introduction to Probability Models", Academic Press Inc., 9^{th} edition..
2. Bhat.B.R (1988), *Modern probability theory*, Wiley Eastern Limited, New Delhi.
3. Medhi.J (1982), *Stochastic Processes,* Wiley Eastern Limited, New Delhi.

Reference Books:

1. Rohatgi.V .K and Ehsanes Saleh. A.K.Md. (2002), *An introduction to Probability and Mathematical Statistics*, Wiley Eastern Limited.
2. Karlin. S and Taylor.H.M., (1975), *A first course in Stochastic processes*, Academic Press, New York
3. Ross.S.M (1982), *Stochastic Processes,* Johnholy & Sons Press, New York.

MT- 2810 Algebra

Category of the Course: MC Hrs/Week: 6
Year & Semester: I & II Credits: 5

Objectives:

- To introduce to the students the general concepts in Abstract Algebra and to give a foundation in various algebraic structures.

Unit 1:

Another counting principle - class equation for finite groups and applications - Sylow's theorems (For theorem 2.12.1, First proof only).

Unit 2:

Direct products - Finite abelian groups (Theorem 2.14.1 only) - Polynomial rings- Polynomials over the Rational Field-Polynomial Rings over Commutative Rings. Modules.

Unit 3:

Extension fields-Roots of polynomials-More about roots

Unit 4:

Elements of Galois theory-Solvability by radicals-Galois Group over the rationals

Unit 5:

Finite fields - Wedderburn's theorem on finite division rings.

Text book:

I.N. Herstein. *Topics in Algebra,* (II Edition) Wiley Eastern Limited, New Delhi, 1975. [Chapters: 2.11, 2.12 (Omit Lemma 2.12.5), 2.13, 2.14 (Theorem 2.14.1 only), 3.9, 3.10,
3.11, 4.5, 5.1, 5.3, 5.5 -5.8, 7.1, 7.2 (Theorem 7.2.1 only)]

References:

1. S.Lang, *Algebra*, 2nd Edition, Addison Wesley(1965).
2. N.Jacobson, *Basic Algebra*, Hindustan Publishing Corpn. Vol I, 1982.
3. M.Artin, *Algebra,* Prentice Hall of India, 1991.

MT- 2811 **Measure Theory and Integration**

Category of the Course: MC Hrs/Week: 6
Year & Semester: I & II Credits: 5

Objectives:

- To provide a basic course in Lebesgue Measure and Integration and a study of inequalities and the L^p-spaces.
- To study signed measures and decomposition theorems.

Unit 1:

Measure on the Real Line: Introduction - Lebesgue Outer Measure - Measurable Sets - Borel Sets - Regular Measure – Measurable Functions - Borel and Lebesgue Measurable Functions.

Unit 2:

Integration of Functions of a Real Variable: Integration of non-negative Functions - Lebesgue Integral - Fatou's Lemma - Lebesgue Monotone Convergence Theorem - The General Integral - Lebesgue Dominated Convergence Theorem – Integration of Series - Riemann and Lebesgue Integrals.

Unit 3:

Abstract Measure Spaces: Measures and Outer Measures - Extension of Measure - Uniqueness of the Extension - Completion of a Measure - Measure Spaces Integration with respect to a Measure.

Unit 4:

Inequalities and the L^P Spaces: L^P Spaces - Convex Functions - Jensen's Inequality - Inequalities of Holder and Minkowski - Convergence in Measure - Almost Uniform Convergence.

Unit 5:

Signed Measures and their Derivatives: Signed measures and the Hahn decomposition –T he Jordan decomposition - The Radon Nikodym Theorem - Some Applications of the Radon Nikodym Theorem**.**

Text book:

G.de Barra, *Measure Theory and Integration*, Wiley Eastern Ltd, 1987.
[Chapters 2.1 – 2.5, 3.1 – 3.4, 5.1 – 5.6, 6.1 – 6.4, 7.1 – 7.2, 8.1 – 8.4]

References:

1. Munroe, M.E., *Introduction to Measure and Integration,* Addison Wesley, Mass, 1953.
2. Rudin, W., *Principles of Mathematical Analysis*, Macmillan, 1968.
3. Halmos, P.R, *Measure theory*, Springer International Student Edition, 1987.
4. Rana, I.K., *An introduction to Measure and Integration*, Narosa Publishing House, 1997.

MT- 2812 Partial Differential Equations

Category of the Course: MC Hrs/Week: 6
Year & Semester: I & II Credits: 5

Objective:

- To give an introduction to Mathematical techniques in analysis of P.D.E. and integral equations.

Unit 1:

First Order Partial Differential Equations –Formulation of first order partial differential equations – Compatibility of first order partial differential equations – Classification of the solutions of first order partial differential equations – Solutions of Non-linear partial differential equations of first order.

Unit 2:

Second Order Partial Differential Equations – Origin of Second Order partial differential equations – Linear partial differential equations with constant coefficients – Method of solving linear partial differential equations – Classification of second order partial differential equations – Riemann's method.

Unit 3:

Elliptic , Parabolic and Hyperbolic Differential Equations – Occurrence of the Laplace and Poisson Equation – Boundary Value Problems – Interior Dirichlet Problem for a circle – Exterior Dirichlet Problem for a circle – Interior Neumann Problem for a circle – Occurrence of the Diffusion equation – Diffusion Equation in cylindrical and spherical coordinates – Transmission Line Problems – Maximum – Minimum principle – Occurrence of the wave equation – Derivation of one – dimensional wave equation – Reduction of one – dimensional wave to canonical form and its solution – D'Alembert's solution of One Dimensional Wave Equation.

Unit 4:

Integral Transforms and Green Function Methods – Laplace Transforms – Solutions of partial differential equations – Fourier Transforms and their applications to partial differential equations – Green Function method and its applications.

Unit 5:

Integral Equations – Linear Integral Equations of the first and second kind of Fredholm and Volterra types – Solution by successive substitutions and successive approximations – Solution of equations with separable Kernels – the Fredholm Alternative – Hilbert-Schmidth theory for symmetric Kernels.

Text Book:

1. J.N. Sharma and Kehar Singh, *Partial Differential Equations for Engineers and Scientists*, Narosa Publishing House, New Delhi, 2000.
   [Chapters 1: Sections 1.3, 1.7, 1.8, 1.9.1 – 1.9.4, Chapters 2: Sections 2.1 – 2.5, Chapters 3: Sections 3.1, 3.2, 3.6 – 3.8, Chapters 4: Sections 4.1, 4.4 – 4.7, Chapters 5: Sections 5.1 – 5.4, Chapters 6: Sections 6.2 – 6.5]
2. M.D.Raisinghania, *Integral Equations and Boundary value problems,* S.Chand, New Delhi, 2007.

[Chapters 1: Sections 1.5 – 1.6, Chapters 5: Sections 5.3,5.5,5.6,5.7&5.11, Chapters 4: Sections 4.1, 4.3, Chapters 1: Sections 7.1a, 7.4]

References:

1. Greenspan Donald, *Introduction to Partial Differential Equations*, Tata Mcgraw Hill, New Delhi, 1961.
2. I.N.Snedden , *Elements of Partial Differential Equations*, Tata Mcgraw Hill, New Delhi,1983
3. Tyn Myint and Lolenath Debnath, *Partial Differential Equations for Scientists and Engineers*, North Hollan, New York, 1987.
4. Robert C. McOwen, *Partial Differential Equations*, Pearson Education, 2004
5. Shanti Swarup, *Integral Equations*, Krishna Prakashan Media (p) Ltd, 1997.
6. S.G.Mikhlin, *Linear Integral Equations*, Hindustan Publishing Corp, Delhi, 1960.

MT- 2814 Complex Analysis

Category of the Course: MC Hrs/Week: 6
Year & Semester: I & II Credits: 5

Objectives:

- To lay the foundation for topics in Advanced Complex Analysis.
- To develop clear thinking and analyzing capacity for research.

Unit 1:

Power series representation of analytic functions – zeros of an analytic function – the index of a closed curve – Cauchy's theorem and integral calculus – the homotopic version of Cauchy's theorem – Goursat's theorem.

Unit 2:

Schwarz lemma – Convex functions – Hadamard's three circles theorem – The Arzela Ascoli theorem – The Riemann mapping theorem.

Unit 3:

Weierstrass factorization theorem – the factorization theorem of the sine function – the Gamma function – the Riemann Zeta function.

Unit 4:

Mittag-Leffler's theorem – Jensen's formula – Hadamard's factorization theorem.

Unit 5:

Simply periodic functions – Doubly periodic functions – Elliptic functions – the Weierstrass theory.

Text Book:

1. John B. Conway, Functions of one complex variable, Springer International Student Edition, 1987. (Unit 1 – Unit 4)
2. Ahlfors L. V., Complex Analysis, 3rd edition, McGraw-Hill, New York, 1986. (Unit 5)

MT- 2962 **Actuarial Mathematics**

Category of the Course: ES Hrs/Week: 4
Year & Semester: I & II Credits: 3

Objective:

- To define, analyze and solve complex business, financial and social problems using the knowledge of mathematics and probability theory.

Unit 1:

Survival models - Survival models, Force of Mortality, Expectation of life, mixed models.

Unit 2:

Life tables - Life tables-Actuarial models-deterministic survivorship and random survivorship group-Continuous computations-interpolating life tables.

Unit 3:

Life insurance - Introduction to life insurance-payments paid at the end of the year of death-Properties of the APV for discrete insurance-Level benefit insurance in the continuous case.

Unit 4:

Life annuities - Whole life annuity-n year deferred, temporary and certain annuity-Contingencies paid m times a year-Non level payments.

Unit 5:

Annual benefit premiums.- Funding a liability-Fully discrete benefit Premiums-Benefit premium paid m times a year-Computing benefit premiums from a life table.

Textbooks:

1. Fundamental of Actuarial Mathematics, David Promislow, Wiley, 2011
2. An introduction to actuarial mathematics, Arujn K Gupta, Tamas Varga, Klewer Academic Publications, 2002
3. Actuarial mathematics for life contingent Risks, David C.M.Dickson, Mary R.Hardy, Howard R.Waters, Cambridge university Press, 2009

MT- 2963 **MATLAB PROGRAMMING**

Category of the course: ES Hrs/Week: 4
Year & Semester: I & II Credits : 3

Objective:

- Understand the Matlab Desktop, Command window and the Graph window
- Be able to do simple and complex calculations using Matlab
- Be able to carry out numerical computations and analyses
- Understand the tools that are essential in solving engineering problems

Unit 1:

Introduction and Basics - Matlab Interactive Sessions – Menus and the toolbar – Computing with Matlab – Script files and the Editor Debugger – Matlab Help System – Programming in Matlab – Arrays – Multi - dimensional Arrays – Element by Element Operations – Polynomial Operations Using Arrays – Cell Arrays – Structure Arrays

Unit 2:

Functions and Files - Elementary Mathematical Functions – User Defined Functions – Advanced Function Programming – Working with Data Files –Program Design and Development – Relational Operators and Logical Variables – Logical Operators and Functions – Conditional Statements – Loops – The Switch Structure – Debugging Mat Lab Programs

Unit 3:

Plotting - XY- plotting functions – Subplots and Overlay plots – Special Plot types – Interactive plotting – Function Discovery – Regression – 3-D plots

Unit 4::

Linear Algebraic Equations and Probability - Elementary Solution Methods – Matrix Methods for (LE) – Cramer's Method – Undetermined Systems – Order Systems – Interpolation – Statistics, Histogram and probability – The Normal Distribution

Unit 5:

Symbolic Processing and Image Processing With Matlab - Symbolic Expressions and Algebra – Algebraic and Transcendental Equations – Calculus – Symbolic Linear Algebra – Vector Graphics – Morphological Image Processing – Filtering.

Text Book:

William J. Palm III, Introduction to Matlab 7 for Engineers, McGraw Hill, 2005.

References:

1. Brian R. Hunt, Ronald L. Lipsmen and Jonathan M. Rosenberg, *A Guide to MATLAB for Beginners and Experienced Users,* Cambridge University Press, 2003.
2. John H. Mathews, Kurtis D. Fink, *Numerical Methods using MATLAB*, Fourth Edition, Pearson Education, 2005.

MT- 3810 Topology

Category of the Course: MC Hrs/Week: 7
Year & Semester: II & III Credits: 5

Objectives:

- To study topological spaces, continuous functions, connectedness, compactness, countability and separation axioms.

Unit 1:

Metric Spaces: Partially ordered sets, lattices, metric spaces, definitions and examples, open sets and closed sets, convergence, completeness and Baires theorem, continuous mappings, spaces of continuous functions, Euclidean and Unitary spaces.

Unit 2:

Topological Spaces: Definitions and examples, elementary concepts, open base and open subbase, weak topologies and the function algebras. Compactness: Compact spaces, product of spaces, Tychonoff's theorem and locally compact spaces and compactness for metric spaces, Ascolis theorem.

Unit 3:

Separation Axioms: T_1 spaces, Hausdorff's spaces, completely regular spaces and normal spaces, Urysohn's lemma, the Tietae extension theorem, the Urysohn's imbedding theorem, the Stone-Cech compactification.

Unit 4:

Connectedness: Connected spaces, the components of a space totally disconnected spaces and locally connected spaces.

Unit 5:

Approximation: The Weierstrass approximation theorem, the Stone-Weierstrass theorem, locally compact Hausdorff spaces, the extended Stone-Weierstrass theorem.

Text book:

George F. Simmons, Introduction to Topology and Modern Analysis, McGraw Hill Book
Company, 2000[Part One Chapters 1 to 7]

References:

1. Dugundji, J., Topology, Prentice Hall of India, New Delhi, 1975.
2. Munkres R. James, A first course in Topology, Pearson Education Pvt. Ltd., Delhi-2002.

MT- 3812 **Classical Mechanics**

Category of the Course: MC Hrs/Week: 7
Year & Semester: II & III Credits: 5

Objectives:

- To provide the student with a thorough mastery both of the fundamentals and of significant contemporary research developments**.**

Unit 1:

Generalized coordinates – constraints – Virtual work and D' Alembert's Principle – Lagrange's equations – Problems using Lagrange's equation – Variational Principle and Lagrange's equations

Unit 2:

Hamilton's principle -Derivation of Lagrange's equation from Hamilton's principle.- Legendre transformation and the Hamilton Canonical equation of motion.-Cyclic coordinates and Routh's procedure -Conservation theorems -Derivation from variational principle

Unit 3:

The principle of least action-The types of periodicity -The discussion of the motion of the Top by Lagrange's method and by Hamilton's method.-The equations of Canonical transformation - Examples – the integral invariants of Poincare'- Lagrange and Poisson brackets and Canonical invariants

Unit 4:

Equation of motion in Poisson bracket -Infinitesimal contact transformation - the angular momentum Poisson brackets relations - Lioville's theorem - The Hamilton - Jacobi equation for Hamilton's principle function.

Unit 5:

The Harmonic Oscillator problem as example of Hamilton – Jacobi method Hamilton's-characheristic function – Separation of variables in Hamilton –Jacobi equation-Action angle variables – The Kepler Problems in Action-angle variables .

Self study: Two dimensional motion of rigid bodies, Theory of small bodies, Kinetic energy, angular momentum

Text book:

Goldstein. H *, Classical Mechanics,* 2nd Edition, Narosa Publishing, 1994.
[Chapters: 1.1 – 1.4, 2.1 – 2.6, 8.2 – 8.6, 9.1,9.5 – 9.7,9.9, 10.1 – 10.4, 10.6 – 10.8]

References:

1. D.T. Greenwood, *Classical Dynamics*, Prentice Hall, 1979.
2. J.L.Synge and B.A.Griffith, *Principle of Mechanics*, McGraw Hill, 1959.
2. D.E.Rutherford, *Classical Mechanics*, Oliver Boyd, New York, 2000.
3. F. Chorlton, *Text book of Dynamics*, Van Nostrand, 1969.

MT- 3813 Operations Research

Category of the Course: MC Hrs/Week: 6
Year & Semester: II & III Credits: 5

Objective:

- To provide the students mathematical techniques to model and analyse decision problems, with effective application to real life in optimization of objectives.

Unit 1:

Linear programming - Linear programming and its formulation– Convex sets and their properties, Graphical solution – infeasible and unbounded LPP's-Simplex method – Big-M(Penalty) method-Two phase simplex method – Dual simplex method and its application in post optimality analysis.

Unit 2:

Integer Programming - Pure and mixed integer programming problems and applications – Cutting plane algorithm – The branch and bound technique.

Dynamic Programming - Characteristics of dynamic programming – Models in dynamic programming – Capital budgeting problem – Shortest route problem.

Unit 3:

Inventory Models - Deterministic models – Single item static model with and without price breaks – multiple item static models with storage limitations – probabilistic models – A continuous review single period models – multiple period models.

Queuing Models - Basic characteristics of queuing system, different performance measures, steady state solution of Markovian queuing models – M/M/1, M/M/C with limited waiting space, M/G/1 queuing models.

Unit 4:

Transportation and assignment problems - Mathematical model of transportation problem- Balanced and unbalanced problems- north west corner rule method- Least cost method-Modi(U-V) method.

Mathematical model of assignment problem- Enumeration method-Hungarian method.

Unit 5:

Non Linear Programming - Optimality conditions - Newtons' method- Lagrangian multiplier method – Kuhn Tucker conditions – Quadratic Programming by Wolfe's Method (Theory only).

Text book:

1. Hamdy A. Taha , " Operations Research:An introduction ", Seventh Edition, Pearson Education Asia Editions
2. Fredrich. S. Hillier and Gerald . J. Liberman, " Operations Research " , Second Edition, CBS Publishers
3. Ravindran, Philips and Soleberg, " Operations Research – Principle and Practice " Second Edition, John Wiley and sons

References:

1. J.K.Sharma," Operations Research", Third Edition, Macmillan Publications._
2. Kantiswarup, Gupta and Man Mohan, " Operations Research ", Twelfth Edition, Sultan Chand and Sons, 2005.
3. Hadley, " Non-linear and dynamic programming", Addition Wesley.
4. Prem Kumar Gupta and D.S.Hira,"Operations Research",S.Chand & Company Ltd, New Delhi,2001.

5. Nash and Sofer,”Linear and nonlinear programming”,McGraw-Hill,1996.

MT- 3875 **MATHEMATICAL FINANCE MODELS**

Cr: 5

Paper: ID

MT- 3964 **Formal Languages and Automata**

Category of the Course: ES Hrs/Week: 4
Year & Semester: II & III Credits: 3

Objectives:

- To provide an insight to theoretical computer science.
- To get across to the students the notion of effective computability, using mathematical models.

Unit 1:

Finite Automata and Regular Expressions - An informal picture of finite automata – Deterministic finite automata - Nondeterministic finite automata An application: Text search – Finite automata with epsilon-transitions – Regular expressions – Finite automata and regular expressions.

Unit 2:

Properties of Regular Languages - Proving languages not to be regular – Closer properties of regular languages – Decision properties of regular languages – Equivalence and minimization of automata.

Unit 3:

Context-Free Grammars and Languages - Context-Free grammars – Parse trees – Ambiguity in grammars and languages – Normal forms for Context Free grammars. CNF and GNF normal forms

Unit 4:

Pushdown Automata - Definition of the pushdown automaton – The languages of a PDA – Equivalence of PDA's and CFG's.

Unit 5:

Introduction to Turing Machines- The Turing machine – Programming techniques for Turing machines – Extensions to the basic Turing machine – A language that is not recursively enumerable.

Text book:

1. Introduction to Automata Theory, Languages, and Computation, Second Edition, Johne E.Hopcroft, Rajeev Motwani, Jeffery D. Ullman, Pearson Education, 2001 [Chapters: 2.1 – 2.5, 3.1 – 3.2, 4.1 – 4.4, 5.1 ,5.2, 5.4, 6.1-6.3, 7.1, 8.2 – 8.4 , 9.1]

References:

1. Linz Peter, *Introduction to Formal Languages and Automata,* Narosa Publishing House, New Delhi, 1999
2. Martin, C. John., *Introduction to Languages and the Theory of Computation.* Tata McGraw Hill, New Delhi, 2006.

MT-3965 **Numerical Analysis**

Category of the Course: Elective Hrs/Week: 4
Year & Semester: II & III Credits: 3

Objective:

- To expose the students to various tools in solving numerical problems and to prepare the students for competitive examinations like GATE, CSIR-NET, SLET, etc.

Unit 1:

Solution of Algebraic and Transcendental Equations -Bisection method - Regula Falsi method - Newton-Raphson method - Rate of convergence - Secant method.

Self - study: Ramanujan's method, Graffe's root-squaring method, Lin-Bairstow's method.

Unit 2:

Interpolation -Errors in polynomial interpolation - Newton's forward and backward interpolation - Gauss central difference formula - Stirling's formula - Bessel's formula - Everett's formula - Lagrange's interpolation formula - Error in Lagrange's formula - Hermite's interpolation formula.

Self - study: Finite differences - Forward, Backward and Central differences - Symbolic relations and separation of symbols - Relation between Bessel's and Everett's formula.

Unit 3:

Numerical Differentiation and Integration -Numerical Differentiation - Errors in numerical differentiation - Maximum and minimum values of a tabulated function. Numerical Integration - Trapezoidal rule - Simpson's 1/3 rule - Simpson's 3/8 rule - Gauss Legendre formula.

Self - study: Cubic Spline method for differentiation - Rmberg integration - Euler-Maclaurin formula.

Unit 4:

Systems of Linear Equations -Direct methods - Gauss elimination method - Gauss-Jordan method - LU decomposition. Iterative methods - Jacobi's method - Gauss-Siedal method. Eigen value problem - Power method.

Self - study: Matrix inverse using Jordan method - Solution of tridiagonal systems - Singular value decomposition.

Unit 5:

Numerical Solution of Ordinary Differential Equations - Initial value problems - Taylor's series method - Picard's method - Euler's method - Modified Euler's method - Runge-Kutta methods. Boundary value problems - Finite difference method - The Shooting method.

Self - study: Error estimates for the Euler method - Milne's method - Cubic Spline method.

Text Book:

Sastry, S.S. , *Introductory Methods of Numerical Analysis*, Fourth Edition, PHI Learning Pvt Ltd.,

New Delhi, 2005. [Chapters: 2, 3, 5, 6, 7]

References:

1. David Kinciad & Ward Cheney, *Numerical Analysis and Mathematics of Scientific Computing*, Brooks/Cole, 1999.
2. Atkinson, K, *Elementary Numerical Analysis*, John Wiley, 1978.
3. Jain, M.K., Iyengar, S.R.K., Jain, R.K., *Numerical Methods for Scientific and Engineering Computations*, Wiley Eastern, 2003.
4. John, H. Mathews, *Numerical Methods for Mathematics, Science and Engineering*, Prentice Hall of India, 1994.
5. Shankara Rao, K., *Numerical Methods for Scientists and Engineers*, Prentice Hall of India, 2001.

MT- 4810 **Functional Analysis**

Category of the Course: MC Hrs/Week: 6
Year & Semester: II & IV Credits: 5

Objectives:

- To study the details of Banach and Hilbert Spaces and to introduce Banach algebras.

Unit 1:

Vector Spaces – Subspaces – Quotient Spaces – Dimension of Vector Spaces, Hamel Basis – Algebraic Dual – Second Dual – Convex Sets – Hahn Banach Theorem – Extension form.

Unit 2:

Banach Spaces – Dual Spaces – Hahn Banach Theorem in Normal Spaces – Uniform Boundedness Principle – Lemma F. Riesz- Application to Compact transformation.

Unit 3:

The Natural Embedding of a Normal Space in its second dual – Reflexivity – Open Mapping and Closed Graph Theorems – Projections.

Unit 4:

Hilbert Spaces – Inner Product – Basis Lemma – Projection Theorem – Dual-Riesz Representation Theorem – Orthonormal sets – Fourier Expansions – Dimensions – Riesz Fischer Theorem – Adjoint of an Operator – Self-adjoint, Normal and Unitary Operator, Projections.

Unit 5:

Finite Dimensional Spectral Theory and Banach Algebra – Finite Dimensional Spectral Theory – Regular and Singular Elements – Topological Divisor of Zero – The Spectrum – Formula for the Spectral Radius – Topological Vector Spaces – Normal Spaces – Locally Convex Spaces – The radical and semi-simplicity – The Gelfand mapping – The Gelfand Mapping Theorem – Involutions in Banach Algebras.

Text book:

Goffman, H.C., Pedrick, G., *First course in Functional Analysis*, Prentice Hall of India, New Delhi, 1987.[Chapters: 2.1 – 2.6, 2.8, 2.9, 2.11 – 2.17, 2.20, 2.21, 4.1, 4.2, 4.4, 4.7, 5.4 – 5.6, 6.6]

References:

1. Limaye, B.V., *Functional Analysis*, Wiley Eastern Ltd, New Delhi, 1986.
2. G.F.Simmons, *Introduction to topology and Modern Analysis*, McGraw Hill InternationalBook Company, New York, 1963.
3. W. Rudin, *Functional Analysis,* Tata McGraw-Hill Publishing Company, New Delhi,1973.
4. G. Bachman and L.Narici, *Functional Analysis* Academic Press, New York, 1966.
5. E. Kreyszig, *Introductory Functional Analysis with Applications*, John wiley & Sons, New York, 1978.

MT – 4815 Advanced Graph Theory

Category of the Course: MC Hrs/Week: 6
Year & Semester: II & IV Credits: 5

Objectives:

- To present a coherent introduction to the subject.
- To emphasize various approaches that has proved fruitful in modern graph theory.

Unit 1:

Fundamental Concepts – The Incidence and Adjacency Matrices – Subgraphs – Vertex Degrees – Degree Sequences – Path and Connection – Cycles – Shortest Path Problem – Dijkstra's algorithm.

Unit 2:

Trees – Cut Edges and Bonds – Cut Vertices – Cayley's formula – Connectivity – Blocks – Euler Tours – Hamilton Cycles – The Chinese Postman Problem – Fleury's algorithm.

Unit 3:

Matchings – Matchings and Coverings in Bipartite Graphs – Perfect Matchings – Edge Colorings – Edge Chromatic Number.

Unit 4:

Independent Sets – Vertex Colorings – Chromatic Number – Brook's Theorem – Chromatic Polynomials.

Unit 5:

Planar Graphs – Euler Formula – Kuratowski's theorem – Five Colour Theorem and Four Colour Conjecture.

Text Books:

A Bondy and U S R Murty, 'Graph Theory with Applications, Macmillan Press Ltd.',1976.[Chapter 1: Sections 1.1 to 1.8, Chapter 2: Sections 2.1 to 2.4, Chapter 3: Sections 3.1 and 3.2, Chapter 4: Section 4.1 to 4.3, Chapter 5: Sections 5.1 to 5.3, Chapter 6: Sections6.1, Chapter 7: Sections 7.1, Chapter 8: Sections 8.1 and 8.2, Chapter 9: Section 9.1, 9.3,9.5 and 9.6].

References:

1. Douglas B West, 'Introduction to Graph Theory', Prentice Hall of India, 2002.
2. Harary F, 'Graph Theory', Narosa Publishing House, New Delhi, 1989.
3. Bezhad M, Chartrand G, Lesneik Foster L, "Graphs and Digraphs", Wadsworth International Group, 1995.

MT- 4816 Fluid Dynamics

Category of the Course: MC Hrs/Week: 6
Year & Semester: II & IV Credits: 5

Objectives:

- To introduce the students to fluids in motion, Equations of motion of a fluid, two-dimensional flows, three-dimensional flows and viscous flows.

Unit 1:

Methods of describing fluid motion – Velocity of a fluid at a point – Streamlines and pathlines; Steady and unsteady flows – Velocity potential – Vorticity vector – Local and particle rates of changes – Equation of continuity – Conditions at a rigid boundary.

Unit 2:

Euler's equation of motion – Bernoulli's equation – Worked examples – Discussion of the case of steady motion under conservative body forces – Some flows involving axial symmetry – Kelvin's theorem – Three-dimensional – Sources, sinks, doublets – Axi-symmetric flows – Stokes's stream function

Unit 3:

Two dimensional flow – The stream function – Complex potential for two-dimensional, irrotational, incompressible flow – Complex velocity potentials for standard two-dimensional flows – Some worked examples – Two dimensional Image systems – Milne Thompson circle Theorem – Theorem of Blasius.

Unit 4:

Kutta-Joukowski's theorem – Joukowski transformation – The aerofoil – Helmholtz's vorticity theorem – Butler sphere theorem.

Unit 5:

Viscous flow – Navier-Stokes equation of motion of a viscous fluid – Some solvable problems in viscous flow – Steady viscous flow in tubes having uniform elliptic cross-section and equilateral triangular cross-section.

Text Books:

1. Chorlton F., *Text book of Fluid Dynamics*, CBS Publications & Distributors, New Delhi, 2004.
   [Chapter 2: sections 2.2 – 2.8, 2.10, Chapter 3: sections 3.4 – 3.7, 3.9, 3.12, Chapter 4: sections 4.2, 4.5, Chapter 5: sections 5.1, 5.3 – 5.9, Chapter 8: sections 8.9, 8.10, 8.11.2, 8.11.3].
2. Raisinghania M. D., *Fluid Dynamics*, S. Chand & Company Ltd, New Delhi, 2006.
   [Chapter 2: section 2.1, Chapter 7: sections 7. 23 – 7. 25, Chapter 9: sections 9.2].

References:

1. Ranald V Giles, Jack B Evett, Cheng Liu, Schaum's Outline of Theory and Problems of Fluid Mechanics and Hydraulics, McGraw-Hill Professional, 1994.
2. Batchelor, C.K., *An Introduction to Fluid Mechanics,* Cambridge University Press, 1967.
3. Milne-Thomson L M, *Theoretical Hydrodynamics*, Courier Dover Publications, 1996.

MT- 4817 **FUZZY SETS AND APPLICATIONS**

Category of the course: MC Hrs/Week: 6
Year & Semester: II / IV Credits : 5

Objectives:

- Fuzzy Sets and Applications is a step forward a rapprochement between the precision of classical mathematics and the pervasive imprecision of the real world- a rapprochement born of the incessant human quest for a better understanding of mental processes and cognition.

Unit 1:

Introduction - Review of the notion of membership – The concept of a fuzzy subset - Dominance relations - Simple operations on fuzzy subsets - Set of fuzzy subsets for E and M finite - Properties of the set of the fuzzy subsets - Product and algebraic sum of two fuzzy subsets.

Unit 2:

Fuzzy graphs-Fuzzy relations-Composition of fuzzy relations -Fuzzy subsets induced by a mapping -Conditioned fuzzy subsets -Properties of fuzzy binary relation -Transitive closure of a fuzzy binary relation-Paths in a finite fuzzy graph

Unit 3:

Fuzzy preorder relations -Similitude sub relations in a fuzzy preorder- Antisymmetry - Fuzzy order relations-Ant symmetric relations without loops - Ordinal relations- Ordinal functions in a fuzzy order relation-Dissimilitude relations –Resemblance relations.

Unit 4:

Pattern recognition, fuzzy clustering and fuzzy pattern recognition.

Unit 5:

Applications: Civil engineering, Industrial engineering, Robotics, Medicine and Economics.

Text book:

1. A.Kaufmann , *Introduction to the Theory of Fuzzy Subsets* - Volume1, Academic Press, New York 1975.
   [Chapter: Sections 1 – 8,10 – 26]
2. Klir G.J. and Yuan Bo, *Fuzzy sets and fuzzy logic: Theory and Applications*, Prentice-Hall of India, New Delhi, 2002.
   [Chapter: Sections 13.1 – 13.3, 16.2, 16.4, 16.7, 17.2, 17.3]

References:

1. Zimmermann, *Fuzzy set theory and its Applications*, Kluwer Academic Publishers, 1975
2. Lotfi A.Zadeh, Fuzzy Sets and Their Applications to Cognitive and Decision Processes, Academic Press, New York, 1975.
3. Bart Kosko, Neural Networks and fuzzy systems, Prentice-Hall of India, New Delhi, 2003.