Course Offered in Spring Semester Department of Mathematics

Batch 2019-21, Semester-II					
1	Mathematical Methods	IAM 404	04	4L, 2T	Dr S K Srivastava
2	Numerical Analysis	IAM 403	04	4L, 2T	Dr R Kumar
3	Real Analysis	MTH 406	04	4L, 2T	Guest Faculty
4	Partial Differential Equations	MTH 402	04	4L, 2T	Guest Faculty
Skill Development					
1	Introduction to Mathematical Statistics	MTH 527	02	2L, 1T	Guest Faculty

Semester II

Credits Equivalent: 04 Credits (One credit is equivalent to 10 hours of lectures / organised classroom activity / contact hours; 5 hours of laboratory work / practical / field work / Tutorial / teacher-led activity and 15 hours of other workload such as independent individual/ group work; obligatory/ optional work placement; literature survey/ library work; data collection/ field work; writing of papers/ projects/dissertation/thesis; seminars, etc.)

Attendance Requirements:
Students are expected to attend all lectures in order to be able to fully benefit from the course. A minimum of 75% attendance is a must failing which a student may not be permitted to appear in examination.

Evaluation Criteria:
1. Mid Term Examination: 25%
2. End Term Examination: 50%
3. Counselling, Activities and Tutorials (CAT): 25%
i. Subjective / Objective Assignment: 10 %
ii. Numerical Assignments using programming: 10 %
iii .Presentations and Class Tests :5 %

Course Name: Mathematical Methods
Course Code: IAM 404
Credits: 04

Course Contents:

Unit I: Review the basic concepts for solving ODE: First order and second order Linear differential equations, Series solution for ODE where x=0 is ordinary point, Leibnitz rule for differentiation of integrals, Cauchy formula for reducing multiple integrals to single integral and Laplace transforms. Integral equations: classification of integral equations; conversion from IVP to Volterra integral equations and conversely; conversion from BVP to Fredholm integral equations and conversely, Integral equations with separable kernels.

Unit II: Method of successive approximations, eigenvalues and eigenfunctions, Resolvent kernels, Symmetric kernels, Hilbert Schmidt theorem and solution of symmetric integral equations.

Unit III: Calculus of Variations: Concept of variation, Linear functional, Euler-Lagrange equation, Necessary and sufficient conditions for extrema, Euler-Lagrange differential equation for n-dependent variables, Functionals dependent on higher order derivatives,

Functionals dependent on functions of several variables.

Unit IV: Applications of calculus of variations to various problems: Shortest distance, minimum surface of revolution, Brachistochrone problem, geodesic, Isoperimetric problem, Calculus of variations for problems in parametric form, Variational problems with moving boundaries.

Prescribed Text Books:

M.D. Raisinghania (2016), Integral equations and boundary value problems, S. Chand Publishing.

I. M. Gelfand and S.V. Fomin (2012): Calculus of Variations, Prentice Hall Inc.

Suggested Additional Readings:

F.G. Tricomi, (1985): Integral Equations, Cambridge University Press.

A. S. Gupta (1996): Calculus of Variations with Applications, Prentice–Hall of India.

Robert Weinstock (1975): Calculus of Variations with applications to Physics and Engineering, Dover Publications Inc.

Course Name: NUMERICAL ANALYSIS

Course Code: IAM 403

Credits: 04

Course Contents:

Unit I: Lagrange and Newton interpolations, interpolations using finite differences, Hermite interpolation, piecewise and spline interpolation, bivariate interpolation.

Unit II: Polynomial approximation: least square approximation, orthogonal polynomials, uniform approximation, rational approximation.

Unit III: Numerical Differentiation and Integration: methods based on interpolation, methods based on undetermined coefficients, composite integration methods, Romberg integration.

Unit IV: Initial and Boundary value problems for ordinary differential equations: Taylor's series method, Euler and modified Euler method, Runge-Kutta methods, stability analysis, finite-difference method, shooting method.

Prescribed Text Books:

1. M.K. Jain, S. R. K. Iyengar and R. K. Jain: Numerical Methods, 6th Edition, New Age International (P) Limited, Publishers, New Delhi.

Suggested Additional Readings:

1. S. S. Sastri; Introductory Methods of Numerical Analysis, PHI Learning Pvt. Ltd., 2005.
2. S.C. Chapra: Applied Numerical Methods with MATLAB, McGraw Hill, 2012.

Course Name: Real Analysis
Course Code: MTH 406
Credits: 04

Course Contents:

Unit-I: Real and complex number systems, Basic Topology: Ordered sets, Fields, The Real field and Complex field, Euclidean spaces, Countable and Uncountable sets, Metric spaces, Compact sets.

Unit-II: Sequence, Series and Continuity: Sequence, subsequence, Convergent sequence, upper and lower limits, Series of non-negative terms, the root and ratio test, Power series and Summation by parts, Absolute convergence, Continuity and compactness, monotonic functions.

Unit-III: Differentiation: Differentiation of a Real valued functions, Mean value theorem, Differentiation of Vector valued functions, L. Hospital Rule, Taylor's Theorem and Derivatives of Higher order.

Unit-IV: Sequence, Series of Functions and Functions of several Variables: Uniform Convergence, Equicontinuous Families of Functions, The Stone-Weierstrass Theorem, Differentiations of a Function of Several Real Variables and the Contraction Principle.

Prescribed Text Book:

- Rudin, Walter, "Principles of Mathematical Analysis", 3rd Edition, McGraw Hill.

Suggested Additional Reading:

1. G.F. Simmons, "Topology and Modern Analysis", 1st Edition, McGraw Hill.
2. Russell A. Gordon, "Real Analysis: A First Course", Addision-Wesley Higher Mathematics Series.

Course Name: PARTIAL DIFFERENTIAL EQUATIONS
Course Code: MTH 402
Credits: 04

Course Contents:

Unit I: Mathematical models leading to partial differential equations, First and second order equations, Cauchy-Kowalewski's theorem (for first order), Classification of second order equations and reduction to standard form, method of characteristics, Riemann's method and applications.
Unit II: Elliptic equations; Laplace and poisson equations, properties of harmonic functions, mean value property, maximum-minimum principle, Green's function approach, Method of images, separation of variables.

Unit III: Parabolic equations; Heat equation, fundamental solution, separation of variables, similarity solution, maximum principle and comparison theorems.

Unit IV: Hyperbolic equations; wave equation, separation of variables, method of eigenfunction, D' Alembert's formula, Duhamel's principle.

Prescribed Text Books:

1. K. Sankara Rao: Introduction to partial differential equations, PHI Learning Private limited, Delhi, 2011.
2. W.A. Strauss; Partial differential equations an introduction, John Wiley & Sons, 2008.

Suggested Additional Readings:

1. D. Bleecker & G. Csordas; Basic partial differential equations, VAN NOSTRAND REINHOLD NewYork, 1992 .
2. M. Renardy & R.C. Rogers: An introduction to partial differential equations, Springer, 2009.
3. H.F. Weinberger: A first course in partial differential equations, Dover, 1995

Skill Development

Course Name: Introduction to Mathematical Statistics
Course Code: MTH 527
Credits: 02

Course Contents:

Course Offered in Spring Semester Department of Mathematics

Unit-I:

Theory of Probability: Mathematical or Classical Definition of Probability, Limitation of Mathematical Probability, Statistical or Empirical Definition of Probability and its Limitations, Algebra of Sets, Limits of Sequence of Sets, Classes of Sets, Axiomatic Approach to Probability, Basic Theorems on Probability, Conditional Probability, Independence of Events, Pairwise Independence, Mutual Independence, Extended Axiom of Addition and Continuity. Bayes Theorem.

Unit-II:

Random Variables and Mathematical Expectation: Random Variables, Distribution Function of Random Variable and its properties, Discrete Random Variable, Probability Mass Function. Continuous Random Variable, Probability Density Function. mathematical expectation of a random variable and its important properties, variance and covariance.

Prescribed Text Book:

- S.C Gupta and V.K. Kapoor. "Fundamentals of Mathematical Statistics", S. Chand & Sons.

Suggested Additional Reading:

Hogg and Craig, "Introduction to Mathematical Statistics" McGraw Hill.