# 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: Vedic Mathematics**

**Course Code: IAM 412**

**Credits: 02**

**Course Objective:** The purpose of this course is to acquaint the students with the quicker arithmetic techniques to solve problems.

**Course Contents:**

**Unit I:** Number system, binary system, permutation combination, probability.

**Unit II:** Ratio and proportion, partnership, percentage, average, profit and loss, allegation, time and work, time and distance.

**Prescribed Text Book:**

M. Tyra, Quicker Maths, BSC Publishing Co. Pvt. Ltd. Delhi, 2017.

**Suggested reading:**

J. Sankaracarya, Vedic Mathematics, Motilal Banarsidass Publishers Delhi 2015.