Teaching Plan: B.Sc. (Physical Sc.) with Mathematics, Semester-5

Discipline A-5: Elements of Real Analysis

Name of Teacher: Dr. Mukesh Kumar

Weeks 1 and 2: Field and order properties of $\mathbb{R}$, basic properties and inequalities of the absolute value of a real number.

Weeks 3 and 4: Bounded above and bounded below sets, Suprema and infima, The completeness axiom and the Archimedean property of $\mathbb{R}$.

Weeks 5 and 6: Convergence of a real sequence, Algebra of limits.

Week 7: The squeeze principle and applications

Weeks 8 and 9: Monotone sequences, Monotone convergence theorem and applications.

Week 10: Cauchy sequences, Cauchy criterion for convergence and applications.

Week 11: Convergence and divergence of infinite series of real numbers, Necessary condition for convergence, Cauchy criterion for convergence of series.

Weeks 12 to 14: Tests for convergence of positive term series, Applications of the integral test, Comparison tests, D'Alembert's ratio test, Cauchy's nth root test, Raabe's test

Week 15: Alternating series, Leibniz alternating series test, Absolute and conditional convergence.

Essential Reading. Denlinger, Charles G. (2011). Elements of Real Analysis. Jones & Bartlett India Pvt. Ltd. Student Edition. Reprinted 2015.

B.Sc. (Hons.) Mathematics (Sem I)

Teaching Plan (DSC-2: Elementary Real Analysis):

Name: Dr. Mukesh Kumar

Weeks 1 to 3: Algebraic and order properties of $\mathbb{R}$, Absolute value of a real number, Bounded above and bounded below sets, Supremum and infimum of a nonempty subset of $\mathbb{R}$, The completeness property of $\mathbb{R}$.

Week 4: Archimedean property, Density of rational numbers in $\mathbb{R}$.

Weeks 5 and 6: Sequences and their limits, Convergent sequence, Limit theorems.

Week 7 and 8: Monotone sequences, Monotone convergence theorem and applications.

Week 9: Subsequences, Bolzano-Weierstrass theorem, Notion of limit superior and limit inferior for bounded sequence with illustrations.

Week 10: Cauchy sequences of real numbers and Cauchy's convergence criterion.

Week 11: Convergence and divergence of infinite series, Sequence of partial sums of infinite series, Necessary condition for convergence, Cauchy criterion for convergence of series.

Weeks 12 and 13: Tests for convergence of positive term series: Statement of the integral test and convergence of *p*-series, Basic comparison test, Limit comparison test, Ratio, root and Raabe's tests.

Weeks 14 and 15: Alternating series, Leibniz test, Absolute and conditional convergence.

References:

1. Bartle, Robert G., & Sherbert, Donald R. (2011). *Introduction to Real Analysis* (4th ed.). John Wiley & Sons. Wiley India Edition 2015.
2. Bilodeau, Gerald G., Thie, Paul R., & Keough, G. E. (2010). *An Introduction to Analysis* (2nd ed.). Jones and Bartlett India Pvt. Ltd. Student Edition. Reprinted 2015.
3. Denlinger, Charles G. (2011). *Elements of Real Analysis*. Jones and Bartlett India Pvt. Ltd. Student Edition. Reprinted 2015.

B.A. (Prog.) with Mathematics (Sem I)
Teaching Plan (DSC-2: Topics in Calculus):

Name: Dr. Mukesh Kumar

δε−**Weeks 1 and 2:** Limit of a function, definition of a limit, Infinite limits, Continuity and types of discontinuities.

Weeks 3 and 4: Differentiability of a function, Successive differentiation: Calculation of the *n*th derivatives, Leibnitz theorem.

Week 5: Partial differentiation, Euler's theorem on homogeneous functions.

Weeks 6 and 7: Rolle's theorem, Mean value theorems and applications to monotonic functions and inequalities.

Weeks 8 and 9: Taylor's theorem with Lagrange's and Cauchy's form of remainders, Definition and examples of convergent sequences and series, Taylor's series, Maclaurin's series $\exp x$, $\sin x$, $\cos x$, $\log(1+x)$ and $(1+x)^m$.

Week 10: Indeterminate forms.

Week 11: Asymptotes (parallel to axes and oblique).

Weeks 12 and 13: Concavity and inflexion points, Singular points (cusp, node and conjugate), Tangents at the origin and nature of singular points, Curve tracing (cartesian and polar equations).

Week 14 and 15: Reduction formulae for $\int \sin^n x dx, \int \cos^n x dx$, and $\int \sin^m x \cos^n x dx$ and their applications.

References:

1. Prasad, Gorakh (2016). *Differential Calculus* (19th ed.). Pothishala Pvt. Ltd. Allahabad.
2. Prasad, Gorakh (2015). *Integral Calculus*. Pothishala Pvt. Ltd. Allahabad.