Teaching Plan:

Teacher: Balram Kindra

Course: B.Sc. (Physical Sciences)

Subject: Mathematics

Semester: 5

Paper(DSC):Elements of Real Analysis

Weeks 1 and 2: Field and order properties of R, basic properties and inequalities of the absolute value of a real number.
[1]: Chapter 1 (Sections 1.1, and 1.2).

Weeks 3 and 4: Bounded above and bounded below sets, Suprema and infima, The completeness axiom and the Archimedean property of R.
[1]: Chapter 1 (Section 1.6 [1.6.1 to 1.6.14, Theorems 1.6.2 and 1.6.10 without proofs]).
[1]: Chapter 1 (Section 1.5 [1.5.1, 1.5.2, and 1.5.9]).

Weeks 5 and 6: Convergence of a real sequence, Algebra of limits.
[1]: Chapter 2 (Section 2.1).
[1]: Chapter 2 (Section 2.2 [2.2.1 to 2.2.14, Theorems 2.2.8, 2.2.12, and 2.2.13 (d to f) without proofs]).

Week 7: The squeeze principle and applications.
[1]: Chapter 2 (Section 2.3 [2.3.1 to 2.3.14, Theorems 2.3.6, 2.3.10, and 2.3.14 without proofs]).

Weeks 8 and 9: Monotone sequences, Monotone convergence theorem and applications.
[1]: Chapter 2 (Section 2.5 [2.5.1 to 2.5.10, Theorems 2.5.5 and 2.5.7 without proofs).

Week 10: Cauchy sequences, Cauchy criterion for convergence and applications.
[1]: Chapter 2 (Section 2.7 [2.7.1 to 2.7.6, Theorem 2.7.4 without proof]).

Week 11: Convergence and divergence of infinite series of real numbers, Necessary condition for convergence, Cauchy criterion for convergence of series.
[1]: Chapter 2 (Section 8.1).

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 *n*th root test, Raabe's test.
[1]: Chapter 2 (Section 8.2 [8.2.1 to 8.2.12, 8.2.14, 8.2.15, 8.2.17, 8.2.21, and 8.2.22, with all theorems without proofs]).

Week 15: Alternating series, Leibniz alternating series test, Absolute and conditional convergence.
[1]: Chapter 2 (Section 8.3 [8.3.1 to 8.3.10, Theorems 8.3.2, and 8.3.4 without proofs]).

Essential Reading

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

Teaching Plan:

Teacher: Balram Kindra

Course: B.Sc. (Math. Hons.)

Subject: Mathematics

Semester: 5

Paper(DSC): Metric Spaces

Weeks 1 and 2: Definition and examples of metric spaces, Sequences in metric spaces.
[1]: Chapter 1 (Section 1.2 [1.2.1, 1.2.2 ((i), (ii), (iv), (v), (vi), (viii), (ix), (x), (xiv)), 1.2.3, and 1.2.4 (i)], and Section 1.3 [1.3.1, 1.3.2, 1.3.3 ((i), (iii), (iv)), and 1.3.5]).

Week 3: Cauchy sequences, Complete metric space.
[1]: Chapter 1 (Section 1.4 [1.4.1 to 1.4.7, and 1.4.11 to 1.4.14((i), (ii))]).

Weeks 4 and 5: Open and closed balls, Neighborhood, Open set, Interior of a set, Limit point of a set, Derived set, Closed set, Closure of a set, Diameter of a set, Cantor's theorem.
[1]: Chapter 2 (Section 2.1[2.1.1 to 2.1.9 (except 2.1.6(ii)), 2.1.12 to 2.1.35, and 2.1.41 to 2.1.44 (except 2.1.42(iv))]).

Week 6: Relativisation and subspaces.
[1]: Chapter 2 (Section 2.2).

Weeks 7 and 8: Continuous mappings, Sequential criterion, and other characterizations of continuity.
[1]: Chapter 3 (Section 3.1 [3.1.1 to 3.1.12, and 3.1.13((i), (ii), (v), (vi))]).

Weeks 9 and 10: Uniform continuity; Homeomorphism, Isometry and equivalent metrics.
[1]: Chapter 3 (Section 3.4 [3.4.1 to 3.4.8], and Section 3.5 [3.5.1 to 3.5.7((i), (ii), (iii))]).

Week 11: Contraction mapping, Banach fixed point theorem.
[1]: Chapter 3 (Section 3.7 [3.7.1 to 3.7.5, except 3.7.2(ii)]).

Weeks 12 and 13: Connectedness, Connected subsets of $\mathbb{R}$, Connectedness and continuous mappings.
[1]: Chapter 4 (Section 4.1 [4.1.1 to 4.1.3, 4.1.4 (statement only), 4.1.5 to 4.1.15]).

Weeks 14 and 15: Compactness and boundedness, Characterizations of compactness, Continuous functions on compact spaces.
[1]: Chapter 5 (Section 5.1 [5.1.1, 5.1.2, 5.1.5, and 5.1.6], Section 5.2 [5.2.1, 5.2.2 (statement only), 5.2.4,
5.2.5, and 5.2.6], and Section 5.3 [5.3.1 to 5.3.8]).

Note: Examples can be discussed in tutorials.

Essential Reading

1. Shirali, Satish & Vasudeva, H. L. (2009). Metric Spaces. Springer. Indian Reprint 2019.