.

University of Calcutta

Syllabus for Choice Based Credit Course (CBCC) on

"*Rudiments of Pure Mathematics*"

offered by Department of Pure Mathematics

Under

CBCS System

2018

Algebra, Discrete Mathematics & Analysis

Semester : III	Credits : 4
Code : CBCC	Full Marks : 50
Minimum number of classes required : 60	

Unit-1 : Abstract Algebra [10 Marks]

- Group theory, properties of group, cyclic group, quotient group, group homomorphism and isomorphism, Sylow's theorems.
- Ring theory, properties of ring, integral domain, ideal, quotient ring, ring homomorphism, polynomial ring, field, few applications of group, ring, field.

Unit-2 : Graph Theory [10 Marks]

- Definition of undirected graphs, Using of graphs to solve different puzzles and problems. Multigraphs. Walks, Trails, Paths, Circuits and cycles, Eulerian circuits and paths. Eulerian graphs, example of Eulerian graphs. Hamiltonian cycles and Hamiltonian graphs.
- Weighted graphs and Travelling salespersons Problem. Dijkstr's algorithm to find shortest path.
- Definition of Trees and their elementary properties. Definition of Planar graphs, Kuratowski's graphs.

Unit-3 : Combinatorics [10 Marks]

- Revisited : Permutations and combinations; Binomial coefficients and Pascal's Triangle. Basic counting principle, The Pigeonhole Principle and its applications.

Unit-4 : Calculus (functions from $\mathbb{R}^n$ to $\mathbb{R}$) [10 Marks]

- Real valued functions of several real variables (i.e., $f : \mathbb{R}^n \to \mathbb{R}$) : scalar field; limit and continuity of scalar fields; derivative of a scalar field with respect to a vector, directional derivatives and partial derivatives, partial derivatives of higher order, total derivatives, gradient of a scalar field, a sufficient condition for differentiability, chain rule for derivatives of a scalar field; Applications to geometry – level sets, tangent planes, etc.

Unit-5 : Metric Space (with special emphasis on $\mathbb{R}$) [10 Marks]

- Metric space and its examples (other than $\mathbb{R}$); subspaces of a metric space; Convergent sequence, Cauchy sequence, Completeness, Cantor's intersection theorem, $\mathbb{R}$ is a complete metric space. Continuous functions on a metric space, sequential criterion of continuous functions (Heine's continuity criterion), Uniform continuity; Compactness and Connectedness of metric spaces, Heine-Borel theorem in $\mathbb{R}$, connected subsets of $\mathbb{R}$. Contraction mappings, Banach fixed point theorem and its applications.

References

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[2] J. A. Gallian; Contemporary Abstract Algebra (8th Edition), Cengage Learning, 2013.

[3] M. R. Adhikari, A. Adhikari; Basic Modern Algebra with Applications, Springer, 2014.

[4] M. K. Sen, S. Ghosh, P. Mukhopadhyay; Topics in abstract Algebra (2nd edition), University Press, Hyderabad, 2006.

[5] Apostol, T., Calculus (Volume II), John Wiley (student Edition 2), 2007.

[6] Horst, R. Beyer, Calculus and Analysis, Wiley, 2010.

[7] Simmons, G. F., Introduction to Topology and Modern Analysis, McGraw-Hill, 2004.

[8] Kumaresan, S., Topology of Metric Spaces, 2nd Ed., Narosa Publishing House, 2011.

[9] N, Deo; Graph Theory with application to Engineering and Computer Science, Prentice Hall of India, New Delhi, 1990.

[10] John Clark, Derek Allan Holton; A First look at Graph Theory, Allied Publishers Ltd. 1995.

[11] D.S. Malik and M.K. Sen: Discrete Mathematical structure: theory and applications, Thomson, Australia, 2004.

[12] Discrete Mathematics , Schaum's Outline, Tata McGraw-Hill, 2003.