Essential Readings
1.   Munkres James R. (2002). Topology (2nd ed.). Prentice Hall of India Pvt. Ltd.
2.   Shirali Satish and Vasudeva, H. L. (2009). Metric Spaces. Springer. Indian Reprint 2019.

Suggestive Readings
•   Kumaresan, S. (2014). Topology of Metric Spaces (2nd ed.). Narosa Publishing House. Delhi.
•   Searcóid, Mícheál Ó (2007). Metric Spaces. Springer-Verlag.
•   Simmons, G. F. (2017). Introduction to Topology and Modern Analysis. McGraw Hill Education. Delhi**.**

DISCIPLINE SPECIFIC ELECTIVE COURSE – 5(iv):
INFORMATION THEORY AND CODING

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Information Theory and Coding	4	3	1	0	Class XII pass with Mathematics	Probability and Statistics, Linear Algebra

Learning Objectives: The main objective of this course is to:
•   Define and comprehend the concepts of information and its relationship with uncertainty and entropy.
•   Apply basic principles of probability theory to measure information content.
•   Learn basic information inequalities and their applications.
•   Introduce error-detecting and error-correcting codes.
•   Learn various decoding techniques.
•   Get exposure to linear codes and bounds on linear codes.

Learning Outcomes: This course will enable the students to:
•   Understand information and entropy, and calculate various entropies.
•   Apply mutual information, conditional entropy, and information-theoretic measures.
•   Know about the detection and correction of errors while transmission.
•   Understand and demonstrate encoding and decoding of linear codes, and gain knowledge about some bounds on linear codes.

SYLLABUS OF DSE-5(iv)

UNIT – I: Concepts of Information Theory   **(15 hours)**
A measure of uncertainty, H function as a measure of uncertainty, Sources and binary sources, Measure of information for two-dimensional discrete finite probability schemes. Entropy,

Joint entropy and conditional entropy, Relative entropy and mutual information, Chain rules for entropy, Conditional relative entropy and conditional mutual information, A measure of mutual information.

UNIT – II: Information Inequality and Coding Theory   (15 hours)

Interpretation of Shannon's fundamental inequalities, Redundancy, Efficiency and channel capacity, Jensen's inequality and its characterizations, The log sum inequality and its applications. Introduction to error detecting and correcting codes, Maximum likelihood decoding, Hamming distance, Nearest neighbour/minimum distance decoding, Distance of a code, Main coding theory problems, Equivalence of codes, Sphere-packing bound, Perfect codes, Balanced block designs, Finite fields, The ISBN code.

UNIT – III: Linear Codes   (15 hours)

Introduction to vector space over finite fields, Linear codes, Bases for linear codes, Encoding and decoding with a linear code, Dual code, Generator and parity check matrices, Nearest neighbour decoding for linear codes, Syndrome decoding. Binary Hamming codes, q-ary Hamming codes.

Essential Readings

1. Cover, Thomas M. and Thomas, Joy A. (2006). Elements of Information Theory (2nd ed.). Wiley India. Indian Reprint 2017.
2. Hill, Raymond. (1996). A First Course in Coding Theory. Oxford University Press.
3. Reza, Fazlollah M. (1961). An Introduction to Information Theory. Dover Publications Inc, New York. Reprint July 2022.

Suggestive Readings

- Bose, R. (2016). Information Theory, Coding and Cryptography (3rd ed.). McGraw-Hill.
- Hamming, R. W. (1980). Coding and Information Theory, Prentice Hall, Englewood.
- Ling, S. and Xing, C. (2004). Coding Theory: A First Course. Cambridge University Press.
- Pless, V. (1998). Introduction to the Theory of Error-Correcting Codes. John-Wiley.
- Sloane, N. J. A. and MacWilliams, F. J. (2007). Theory of Error Correcting Codes. North-Holland Mathematical Library 16, North-Holland.

DISCIPLINE SPECIFIC ELECTIVE COURSE – 5(v): OPTIMIZATION

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Optimization	4	3	1	0	Class XII pass with Mathematics	Multivariate Calculus