INDIAN INSTITUTE OF TECHNOLOGY TIRUPATI
भारतीय प्रौद्योगिकी संस्थान तिरुपति
Yerpedu-Venkatagiri Road, Yerpedu Post, Tirupati District, Andhra Pradesh - 517 619

1.	Title of the course	Accelerating Sparse Computations
2.	Course number	CS538L
3.	Structure of credits (L-T-P-C)	3-0-0-3
4.	New course/modification to	New
5.	To be offered by	Computer Science and Engineering
6.	Prerequisite	CoT
7.	**Course Objective(s):** To identify fundamental concepts of sparsity, and how it can be leveraged to optimize computational performance. To explore techniques for efficiently working with sparse matrices and tensors, which are commonly used in various fields such as machine learning, scientific computing, and data analysis.	
8.	**Course Content:** Overview of parallel computing; Sparse matrices: graph representations, storage schemes, basic sparse matrix operations; Parallel matrix-vector products; Parallel preconditioners: block-Jacobi, polynomial, distributed Incomplete LU factorizations (ILU), Symmetric Successive Over-Relaxation (SSOR); Tensors: sparse tensor storage formats, parallel implementation of sparse tensor operations; Compiler support for sparse tensor computations in Multi-Level Intermediate Representation (MLIR); Hardware accelerators for sparse tensor algebra; Sparsity in deep learning.	
9.	**Textbook(s):** 1. Saad Y, Iterative Methods for Sparse Linear Systems, 2nd Edition, SIAM (2003).	
10.	**Reference(s):** 1. Kolda T G and Bader B W, Tensor Decompositions and Applications, SIAM (2009). 2. Hoefler T, Alistarh D, Ben-Nun T, Dryden N, Peste A, Sparsity in Deep Learning: Pruning and growth for efficient inference and training in neural networks, arXiv:2102.00554 (2021). 3. Bik A, Koanantakool P, Shpeisman T, Vasilache N, Zheng B, Kjolstad F, Compiler Support for Sparse Tensor Computations in MLIR, ACM (2022).	