**Department of Electrical Engineering, IIT Madras**

**EE5141** : Cellular and Wireless Communications Fundamentals

## List of Topics for Mini-Project -- 2026

1. Any MIMO-OFDM precoding and/or detection algorithm from the below review paper:
*Ref: S. Yang and L. Hanzo, "Fifty years of MIMO detection: the Road to Large-scale MIMO,".*

2. Filterbank Multicarrier (FBMC) block modulation study
*Ref: B. Farhang-Boroujeny, "OFDM versus filter bank multicarrier," in IEEE Signal Processing Magazine, May 2011.*

3. Generalized Frequency Division multiplexing (GFDM) study
*Ref: (a) G. Fettweis, G. M. Krondor,f and S. Bittner, "GFDM: Generalized frequency division multiplexing," in IEEE Vehicular Technology Conference (VTC Spring09), April 2009.*
*(b) N. Michailow, M. Matthe, I. S. Gaspar, A. Caldevilla, and L. Mendes,"Generalized frequency division multiplexing for 5th generation cellular networks," IEEE Trans. Commun., 2014*

4. Universal Filtered Multicarrier (UFMC) study
*Ref: V. Vakilian et al., "Universal Filtered Multicarrier Technique for Wireless Systems beyond LTE," IEEE Globecom-13, GA, Dec. 2013.*

*For topics* 2-4*, and for other 5G waveform candidates, see the contribution #162119 to 3GPP-RAN1 in April 2016. You can also see G.Wunder et al, "5GNOW – Non-orthogonal Asynchronous waveforms for future mobile applications," pp.97-105, IEEE Communications Magazine, Feb.2014.*

6. Blind / semi-blind / non-coherent OFDM receivers – study and compare with coherent receiver
*Ref:* See Hanzo's book on MC-CDMA and OFDM; also consider differentially encoded PSK symbols to build non-coherent OFDM receivers with differential (non-coherent) detection

7. Biased channel estimator for OFDMA; as an example, look at the James-Stein estimator in the reference list paper: *Ref: Sheetal Kalyani, R. Lakshminarayanan, and K. Giridhar. "Biased estimators with adaptive shrinkage targets for orthogonal frequency division multiple access channel estimation." IET Communications7.1 (2013): 13-22*

8. Space-time Block Codes and Space-frequency Block codes for OFDM links
(e.g., Alamouti code). See D.Tse and P.Viswanath's book

9. Turbo-coded OFDM (convolutional turbo code mapped to various OFDM/OFDMA subcarriers

10. Multi-carrier Direct Sequence CDMA (MC-DS-CDMA) – frequency domain channel equalization followed by dispreading *Ref:* See Hanzo's book on MC-CDMA and OFDM; Kaiser's book.

11. Interleaved FDMA and FDOSS – PAPR comparision with OFDMA and DFT-spread OFDMA
*Ref:* Presentation on Generalised Multi-carrier (gmc.pdf) on the URL.

Note: Topics #1 or #6 can be chosen by more than one student. Any other interesting and relevant topic is also fine, but discuss that with the me first.

K. Giridhar, Apr. 2026