# Constellation Design for Simultaneous Wireless Information and Power Transfer (SWIPT)

Your task will be to analyze and design different constellations considering the trade-offs inherent in simultaneous wireless information and power transfer (SWIPT) systems. More specifically, given that energy harvesting is related to the peak-to-average power ratio (PAPR) and the symbol error probability (SEP) is a function of the minimum Euclidean distance $d_{min}$, this project will focus on this trade-off to design optimal constellations for SWIPT. You will be divided into teams of one or two people and each team will be responsible for the following tasks:

1) Fig. 2 in [R1] represents the PAPR behavior versus $d_{min}$ of 16-Circular QAM compared with known modulation schemes, namely 16-PAM, 16-PSK, and 16-QAM. Provide theoretical analysis about PAPR versus $d_{min}$ for all the above constellations and verify the results in Fig. 2 through simulation. [Grade:1.0]
2) Fig. 3 in [R1] illustrates SEP versus normalized harvested energy of the modulation schemes for fixed SNR. Furthermore, Fig. 4 in [R1] illustrates SEP versus SNR for fixed normalized energy harvesting. Verify these results through both theoretical analysis and simulation results. Include in your analysis, one of the state-of-the-art constellation schemes for SWIPT presented in [R2]. [Grade:1.0]
3) Design constellations for optimal SWIPT beyond those proposed in the current state-of the-art. [Grade: 1.5]


[R1] G. M. Kraidy, C. Psomas and I. Krikidis, "Fundamentals of Circular QAM for Wireless Information and Power Transfer," *2021 IEEE 22nd International Workshop on Signal Processing Advances in Wireless Communications (SPAWC)*, Lucca, Italy, 2021

[R2] M. J. L. Morales, K. Chen-Hu and A. G. Armada, "Optimum Constellation for Symbol-Error-Rate to PAPR Ratio Minimization in SWIPT," *2022 IEEE 95th Vehicular Technology Conference: (VTC2022-Spring)*, Helsinki, Finland, 2022