

EE6129 Wireless and Mobile Radio Systems
Part 2 Continuous Assignment (CA2)

1. In a modulation scheme, every 3 bits of information are grouped together and transmitted in a single modulated signal over the interval $[0, T]$. 1 of the 3 bits is carried in the amplitude A_i and the remaining 2 bits are carried in the phase ϕ_j . The modulated waveform is as given below,

$$A_i \sin\left(\frac{2\pi t}{T} + \phi_j\right)$$

- a) Derive the basis function of this modulated signal.
 - b) Sketch and label the signal constellation of this signal. Show your working clearly.
2. Upon graduation from EEE, you start your career in a Patent Office. A new start-up, wants to file a patent for a space-time code. The company claims that the code can achieve the same rate as that of the Alamouti scheme at reduced complexity. The idea is to transmit the same symbol from each of the two antennas in one time slot. You have been asked to evaluate this patent. In evaluating this patent, you have considered BPSK signals and perfect channel knowledge at the receiver, and derived an equivalent scalar input-output relationship for the proposed system as,

$$y = (h_1 + h_2) \sqrt{\frac{E_s}{2}} s + w$$

where s is the unit-energy transmitted symbol value, E_s is the total energy per symbol at the transmitter, h_1 and h_2 are the channel gains, and w is the additive noise. Using this, and with any additional necessary and appropriate assumptions, you are required to address the following issues.

- a) What is the bit error probability of this system? You may express your answer in terms of Q-function.
 - b) Argue that the proposed scheme does or does not provide diversity gain. Your answer should be concise and be written within one page (A4).
 - c) Does it provide array gain? Explain your answer. Your answer should be concise and be written within one page (A4).
3. Write an essay on: “How Progresses in MIMO Technology Contributes to the 4G and 5G Mobile Networks”. Your essay should be concise with about 2 to 4 pages using A4 size paper, Times New Roman 12pt font, and 1.15 line-spacing. The list of reference materials can be included in an appendix (not part of the 2-4 pages).