Q. 1 Consider the design of an OFDM system. The goal is to transmit data at a rate of 2.4 MBPS using 16-QAM with an available bandwidth of 600 KHz. It is known that the delay spread of the channel is up to a maximum of 20μ seconds. You can assume a cyclic prefix interval equal to the max delay spread. Four guard channels at each end of the signal spectrum also required. Find the total number of subcarriers and total transmission time of an OFDM symbol. **(8 marks)**

Q. 2 Consider an angle modulated signal

$$x_c(t) = 10\cos(\omega_c t + 3\sin\omega_m t)$$

where, f_m = 1k Hz **(8 marks)**

(a) Determine modulation index and bandwidth when (i) f_m is doubled, and (ii) f_m is reduced by half. Considering $X_c(t)$ is PM signal.

(b) Determine modulation index and bandwidth when (i) f_m is doubled, and (ii) f_m is reduced by half. Considering $X_c(t)$ is FM signal.

(c) Determine power of the angle modulated signal

(d) Show that the narrowband FM signal converges to an amplitude modulated signal.