CHAPTER 4

CONCLUSION

The conclusions of the research work carried out and the future scope are discussed in this Chapter. The theoretical investigation carried out to establish incoherent CDMA over multimode fiber optic channel, revealed the following:

(i) The maximum achievable bandwidth in a multimode fiber optic channel is highly sensitive to changes in the refractive index profile parameter $\alpha$. The optimum $\alpha$ depends on the wavelength of operation. For the three distinct wavelengths of 850 nm, 1300 nm and 1550 nm, the maximum bandwidth of 0.59 GHz is achieved for distinct values of $\alpha$ being 2.03525, 1.86453 and 1.78205 respectively. For the above values the optimum values of $\alpha$ show a considerable decrease as the operating wavelength is increased from 850 nm to 1550 nm in the Far Infra-Red range. Hence, based on the wavelength of operation of the Fiber Optic CDMA system, the grading should be appropriately chosen to achieve useful communication over the multimode fiber optic channel.

(ii) The modal noise has significant effects on the performance of the Fiber Optic CDMA communication system. Smaller values of $n_\gamma$ correspond to severe modal noise fluctuations and the system requires a higher signal power to maintain the required level of bit error probability. However the effect of modal noise decreases as the number of simultaneous users increase. When modal noise fluctuation is severe, increase in the number of simultaneous users
affects the BER probability only at higher signaling rates. When the modal noise fluctuations is reduced, the multiple user interference becomes a significant parameter in the determination of the BER probability. As $n_{\gamma}$ increases the system performance with respect to the BER probability approaches that of the system where modal noise is not present. There is a limit on the variance of the modal noise below which its effect can be neglected. The limiting value of $n_{\gamma}$ decreases for increase in the number of simultaneous users in the network.

(iii) OOO signaling schemes can be used only at very low signaling rates. At higher signaling rates, EWO signaling schemes show a better performance. It is also noted that Fiber Optic CDMA systems with EWO signaling scheme can withstand a higher level of modal noise than systems with OOO signaling scheme for the same level of BER probability. Hence, the effect of modal noise is less pronounced in EWO signaling systems. The capacity of the Fiber Optic CDMA network is increased by employing EWO signaling schemes with Prime codes as the addressing sequence.

(iv) At a given mean signaling rate, there is an optimum value for the mean gain of APD for $P_{\text{be}}$ minimum. This optimum mean gain of APD decreases as $K$ increases. Also, at higher signaling rates the gain required is lower. The optimum APD gain requirement is similar for OOCs, Prime codes and QCCs.

(v) The M-ary orthogonal signaling scheme shows a better performance compared to the binary signaling scheme. At fixed bit rate and transmitted power, the BER probability achieved by M-ary orthogonal signaling in Fiber Optic CDMA network is significantly lower than that of the binary signaling scheme. Also the effect of modal noise on the BER probability can be reduced by going for higher values of M.
compared to the baseband binary case. For lower values of transmitted powers, increasing $M$ leads to increase in the optimum mean gain of APD. However as the transmitted power increases, there is not much change in the optimum mean gain of APD for increasing $M$. The number of simultaneous users that the Fiber Optic CDMA network can support for a BER probability $10^{-9}$, is increased by employing $M$-ary orthogonal signaling.

The use of incoherent CDMA over a multimode fiber-optic channel including the various noises present in the system by employing different types of coding and signaling schemes are investigated. Future research in this area can be carried out in developing an improved channel model including the effects of intermodal and intramodal dispersions. The improved channel model can be included in the analysis to study the effects of intersymbol interference in a Fiber Optic CDMA system employing binary and $M$-ary orthogonal signaling schemes.