(b) Describe the procedure for initializing the 8251 in synchronous *vs.* asynchronous mode. 5

(c) Explain the source coding theorem for a noiseless channel. Define coding efficiency, code length, and average information and explain their relationship. 7

7. (a) Define and differentiate between Local Area Network (LAN), Metropolitan Area Network (MAN) and Wide Area Network (WAN). 5

(b) Describe the construction and operation of a PIN photodiode. Explain the significance of the intrinsic region in its performance. 5

(c) Compare the performance characteristics of LEDs and LASERs as optical sources in fiber communication. 5

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Total Pages : 04

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May 2026

M.Sc. (Physics) (Fourth Semester)

Digital Electronics (PHP-232-V)

Time : 3 *Hours*] [*Maximum Marks :* 75

Note : It is compulsory to answer all the questions (1.5 marks each) of Part A in short. Answer any *four* questions from Part B in detail. Different sub-parts of a question are to be attempted adjacent to each other.

Part A

1. (a) Define Signal-to-Noise Ratio (SNR). **1.5**

(b) Define impulse response and step response of a system. **1.5**

(c) What are cyclic codes ? **1.5**

(d) Write a formula for maximum distance for line-of-sight communication when the height of the transmitting and receiving antennas is given. **1.5**

(e) What is differential PSK ? **1.5**

(f) State one difference between step index and graded index fiber. **1.5**

(g) What are optical couplers ? **1.5**

(h) Find Numerical Aperture for $n_1 = 1.5$, $n_2 = 1.47$. **1.5**

(i) Calculate noise figure if $SNR_{in} = 40$ dB and $SNR_{out} = 30$ dB. **1.5**

(j) Calculate the baud rate of ASK signal having a bit rate of 400 bps. **1.5**

Part B

2. (a) Compare analog and digital communication systems. Explain, why digital communication is more immune to noise ? **5**

(b) State and explain Shannon's channel capacity theorem. What are its implications for communication system design regarding bandwidth and SNR ? **5**

(c) Draw the block diagram of a general communication system. Discuss the trade-offs between bandwidth, power, and noise in selecting a channel. **5**

3. (a) Describe the encoder implementation of a linear block code using shift registers. How is the syndrome computed at the receiver to detect and correct errors in the presence of noise ? **8**

(b) State and prove the Shannon-Hartley theorem. Discuss the trade-off between power and bandwidth in achieving a specific capacity, and explain the physical meaning of the Shannon limit. **7**

4. (a) Describe the generation and detection of Binary Frequency Shift Keying (BFSK) signals. Derive the power spectral density (PSD) and calculate the bandwidth required. Compare its performance with BPSK. **8**

(b) How many control signals are there in 8251. Discuss the significance of modem control signals in 8251 during serial data communication. **7**

5. (a) Define Normalized Frequency (V-number) and derive its expression. Explain its significance in determining whether a fiber is single-mode or multi-mode. **7**

(b) Describe the difference between connectors and splices. Explain the process of fusion splicing and the criteria for low-loss splicing. **8**

6. (a) If a communication channel has bandwidth = 1 MHz, Signal power = 10 W and Noise power = 1 W, find its channel capacity. **3**