1. Explain the sampling theory.

* Sampling theory: A signal can be exactly reproduced if it is sampled at the rate f which is greater than twice the maximum frequency W

1. Show the theoretical maximum transfer rate of noisy communication channel. Suppose the bandwidth of the channel is B and the signal-to-noise ratio is R. What can you tell from this equation?

* Shannon capacity: C = B \* log(1 + 10 ^ (R / 10))

1. Give the maximum transfer rate of telephone line with 3 kHz bandwidth and 30 dB  
   signal-to-noise ratio.

* C = B \* log(1 + 10 ^ (R / 10)) = 29901 bps

1. Describe the difference between baseband communication and broadband communication? Give some features on each technology.

* Baseband:
  + 50-Ohm cable, used for digital transmission
  + Uses Manchester encoding, geographical limit is a few kilometers
* Broadband:
  + 75-Ohm cable, CATV system standard
  + Used for both analog and digital signaling

1. Explain the technology called modulation. Give three examples.

* Modulation: modulate carrier frequency with analog data
* Amplitude Shift Key (ASK): encodes 0/1 by difference amplitudes, fond to sudden gain change and inefficient
* Frequency Shift Key (FSK): 0/1 represented by different frequencies, less fond to error than ASK
* Phase Shift Key (PSK): phase of carrier signal is shifted to represent data

1. Suppose a transmission system uses a symbol that carries n bits of information and the baud rate is b, what is the resulting data transfer rate in bits/second?

* Bps = b \* n

1. What does the multiplexing mean? Give some examples.

* Multiplexing: Technique that allow simultaneous transmission of multiple signal across a single data link
* Time division multiplexing (TDM): Dividing transmission time among signals
* Frequency division multiplexing (FDM): Each signal is modulated to a different frequency to avoid overlapping
* Code division multiplexing
* Wavelength division multiplexing

1. Give some features of Manchester coding in comparison with RZ and NRZ coding.

* Manchester: It has transition in the middle of each bit period. Transition serves as clock and data
* NRZL: high voltage = 0, low voltage = 1, voltage constant during bit periods
* NRZI: no transition = 0, transition = 1. Data represent by changes rather than levels

1. Discuss the difference between coaxial cables and twisted pair cables.

* Twisted pair cables: Two insulated wires arranged in a spiral pattern. The signal is transmitted through one wire and a ground reference is transmitted in the other wire.

Limited in distance, bandwidth and data rate due to problems with attenuation, interference and noise

* Coaxil cables: Coaxial cable has better noise immunity for higher frequencies than twisted pair and provides much higher bandwidth than twisted pair

1. Optical fiber is categorized into two groups; single mode fibers and multi mode fibers. Explain their structures and characteristics.
2. Give some features of satellite communication systems.