Due 2 pm, 06 Feb.

1(a) List the seven network layers of the OSI model and briefly (one line each) explain their functions.
Application layer: Defines protocols for a wide variety of applications based on client-server paradigm
Presentation layer: Defines syntax and semantics of information
Session Layer: Manages sessions, dialog control, and synchronization
Transport Layer: Breaking up application data into manageable packets, and delivering packets from one process to another process
Network Layer: Routing network packets from one host in the network to another host
Datalink layer: Sending data frames from one host to another when a direct connection exists between the two hosts, mechanisms for delineating different frames, error control.
Physical layer: Converting sequences of bits to voltage/current patterns or electromagnetic waves for physical delivery over a medium.

(b) What are the “missing” layers in the TCP/IP network model? How are the functions of the two layers handled in the TCP/IP model?
Presentation layer: Handled by the application layer by employing utility functions like ntohs(), ntohl(), htons(), htonl() etc.
Session layer: Handled by the application layer – for example using cookies.

2(a) Briefly explain the function of the following socket system calls: (7 pts)
1. bind(): Set the from address of a socket.
2. connect(): Establish a two-way connection between the socket and a socket specified by the to address
3. shutdown(): Close the connection between two sockets in the direction(s) specified
4. listen(): Set the queue length for the listening socket
5. recvfrom(): Wait for a UDP packet and return the address of the sender
6. sendto(): Send a UDP packet to the socket specified.
7. accept(): Accept a connection request and return a new socket connected to the sender.

(b) Describe the purpose of the following network related functions: (4 points)
1. getsockname(): Get the local address of the queried socket
2. getpeername(): Get the remote address of the queried socket (the remote socket to which the queried local socket is connected)
3. gethostname(): Get the address corresponding to a domain name from /etc/hosts file
4. gethostbyname(): Interface to the domain name system. Return the IP address corresponding to the domain name.
5. htonl(): Convert a sequence of 32 bits (long integer) in host byte order to network byte order.

3. What the achievable bit-rate for a channel with bandwidth of 20,000 Hz, if the SNR is 30 dB?
   \[
   SNR = 10 \log_{10}\left(\frac{S}{N}\right) = 30; \Rightarrow \frac{S}{N} = 10^{\frac{30}{10}} = 1000; \text{Bandwidth} = 20,000; \\
   \text{Bit Rate} = H \log_2\left(1 + \frac{S}{N}\right) = 20000 \times \log_2\left(1 + 1000\right) \approx 199345 \text{ bits per sec}
   \]

4. A communication channel employs a QAM-N scheme at a baud rate of 2400 symbols per second.
   If the bit rate of the channel is 58000 bits per second, what is N (for QAM-N)?

Symbols per second = 2400.
Desired bits per second = 58,000
Bits per symbol = 58000/2400 = 24.167

Possible number of unique bit sequences per symbol is \(2^{24.167}\approx 18.8\) million

N = 18.8 million.