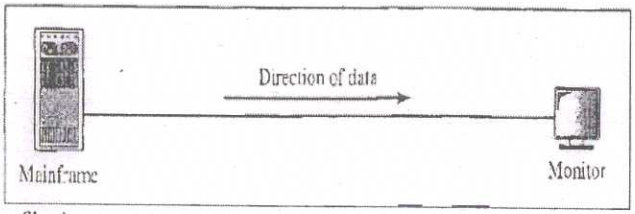
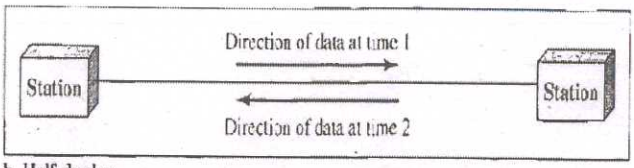
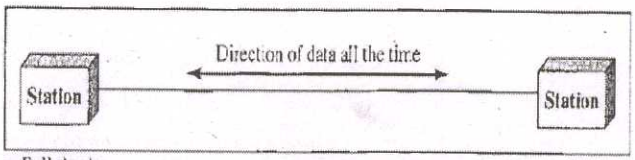
SCHEME OF VALUATION

(Scoring Indicators)

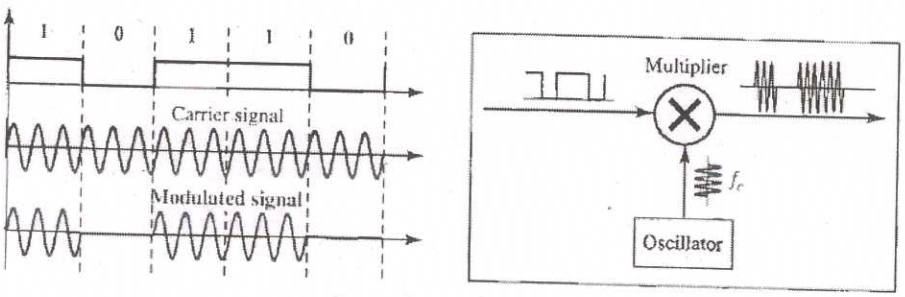
Revision: 2015 Course Code: 4132

Course Title: DATA COMMUNICATION

Qst. No	Scoring Indicator	Split up score	Sub Total	Total
I	**PART – A**			
1	Message, Sender, Receiver, Transmission Medium, Protocol (Any four)	4x½	2	
2	Bit rate is the number of bits sent in 1s, expressed in bits per second (bps).	2	2	
3	Parabolic dish antenna, Horn antenna	2x1	2	10
4	A burst error means that two or more bits in the data unit have changed	2	2	
5	Byte stuffing is process of adding 1 extra byte whenever there is a flag or escape character in the text	2	2	
II	**PART – B**			
1	• Listing of data flow methods - Simplex, Half-duplex, Full-duplex	1½		
	• Diagram	1½		
	 a. Simplex			
	 b. Half-duplex		6	
	 c. Full-duplex			
	• Simplex mode – Unidirectional. Only one of the two devices can transmit; other can only receive	1		
	• Half-duplex – Each station can both transmit and receive, but not at the same time. When one device is sending, the other can only receive, and vice versa.	1		

	• Full-duplex – Both stations can transmit and receive simultaneously.	1		
2	<table><tr><th>Baseband transmission</th><th>Broadband transmission</th></tr><tr><td>• Transmission of digital signal without changing into analog • Uses low-pass channel • Less availability of low-pass channel • No need of conversion • Approximation is used (Any THREE)</td><td>• Transmission of digital signal by changing into analog signal • Uses bandpass channel • More availability of bandpass channel • Need to convert digital signal to an analog signal before transmission • Modulation is used (Any THREE)</td></tr></table>	3 x 2	6	
3	Advantages • Higher bandwidth • Less signal attenuation • Immunity to electromagnetic interference • Resistance to corrosive materials • Light weight • Greater immunity to tapping Disadvantages • Installation and maintenance • Unidirectional light propagation • Cost	3 3	6	
4	• One of the most common protocols for point to point protocol (PPP). • Millions of Internet users who need to connect their home computers to the server of Internet Service Provider use PPP. • To control and manage the transfer of data, there is a need for a point-to-point protocol at data link layer. • PPP provides several services:	½ ½ 1 4	6	

	1. PPP defines the format of the frame to be exchanged between devices. 2. PPP defines how two devices can negotiate the establishment of the link and the exchange of data. 3. PPP defines how network layer data are encapsulated in the data link frame. 4. PPP defines how two devices can authenticate each other. 5. PPP provides multiple network layer services supporting a variety of network layer protocols. 6. PPP provides connections over multiple links.			
5	The category in which a n/w falls is determined by its size. • LAN – Description & diagram • WAN – Description & diagram • MAN – Description & diagram • Internetwork – Description & diagram	 1½ 1½ 1½ 1½	6	

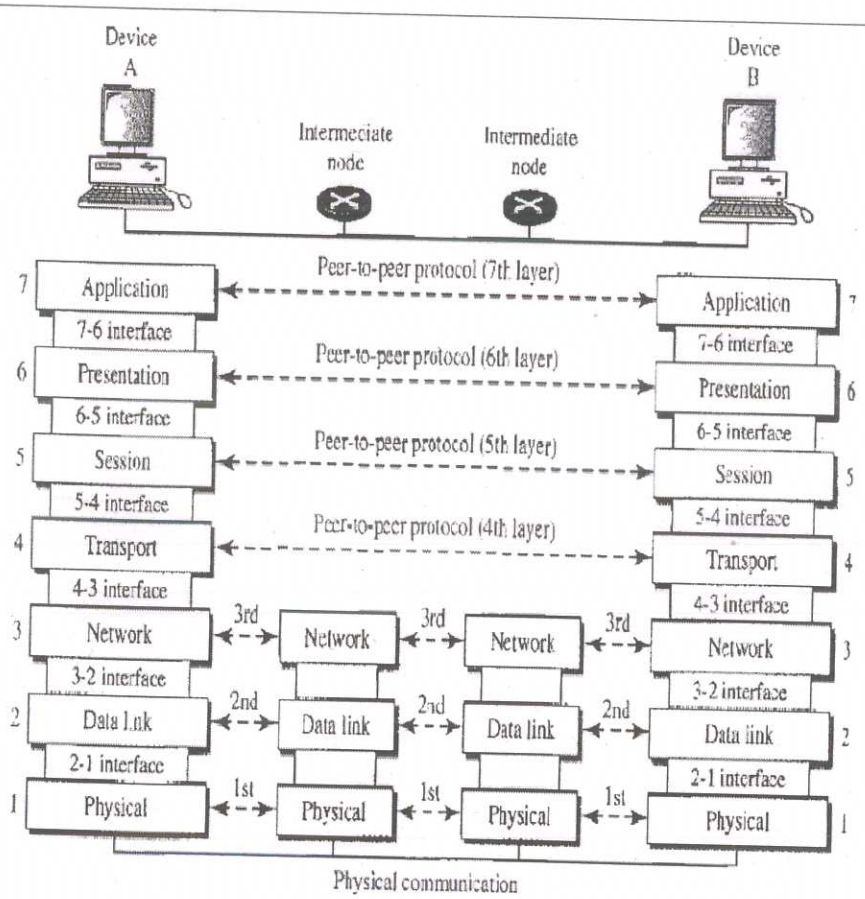
6	• Amplitude of the carrier signal is varied to create signal elements.
	• Frequency and Phase remain constant
	• Binary ASK
	  • ASK implemented using only two levels
	  • On-Off Keying (OOK)
	• Multilevel ASK
	  • More than two levels
	  • Not implemented with pure ASK
	  • Implemented with QAM
	Diagram
	 
		1
		1
		2
		2
			6	

7	Circuit Switching Vs Packet Switching (Any FOUR)	4 x 1½	6	

Circuit Switching	Packet Switching
Physical path between source and destination	No physical path
All packets use same path	Packets travel independently
Reserve the entire bandwidth in advance	Does not reserve
Bandwidth Wastage	No Bandwidth wastage
No store and forward transmission	Supports store and forward transmission

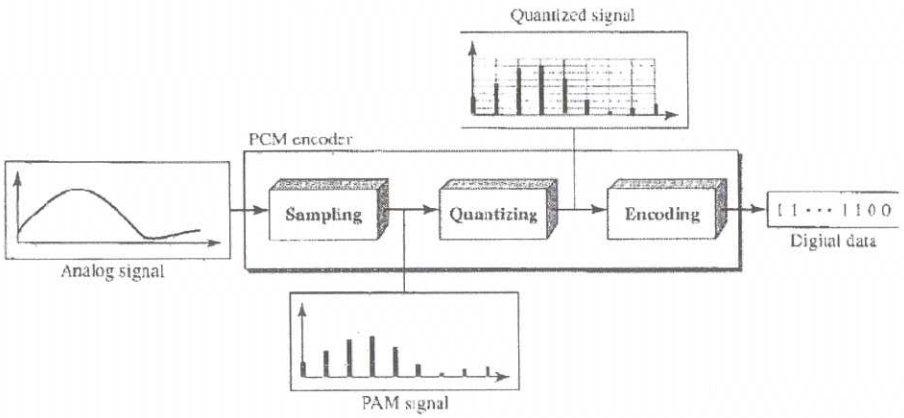
3

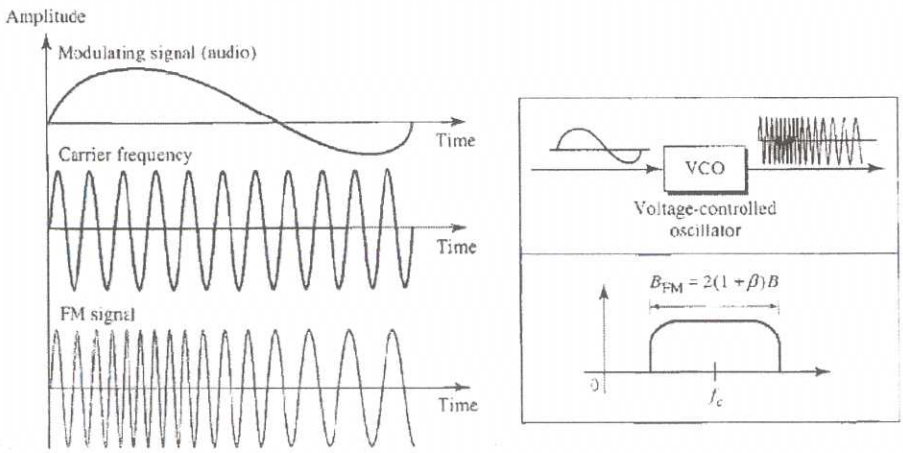
III a)	Performance ◦ Measured in many ways - Transit time, Response time ◦ Depends on a number of factors - Number of users, Type of transmission medium, Capabilities of the connected hardware, Efficiency of the software ◦ Evaluated by two networking metrics – Throughput, Delay	3	6	15
	Reliability ◦ Measured by the frequency of failure, the time it takes a link to recover from a failure and the network's robustness in a catastrophe.	1		
	Security ◦ Protecting data from unauthorized access ◦ Protecting data from damage and development ◦ Implementing policies and procedures for recovery from breaches and data loss	2		
III b)	**Text** In data communications, text is represented as a bit pattern, a sequence of bits (0s or 1s). Different sets of bit patterns have been designed to represent text symbols. Each set is called a code, and the process of representing symbols is called coding. Unicode and ASCII.	2	9	
	NumbersNumbers are also represented by bit patterns. However, a code such as ASCII is not used to represent numbers; the number is directly converted to a binary number to simplify mathematical operations.	1		
	Images Images are also represented by bit patterns. In its simplest form, an image is composed of a matrix of pixels (picture elements), where each pixel is a small dot. The size of the pixel depends on the resolution. After an image is divided into pixels, each pixel is assigned a bit pattern. The size and the value of the pattern depend on the image. black& white, gray scale, RGB and YCM.	3		
	Audio Audio refers to the recording or broadcasting of sound or music. Even when we use a microphone to change voice or music to an electric signal, we create a continuous signal.	1		
	Video Video refers to the recording or broadcasting of a picture or movie. Video can either be produced as a continuous entity (e.g., by a TV camera), or it can be a combination of images, each a discrete entity, arranged to convey the idea of motion.	2		

IV		3		
	• **Physical Layer** ○ Physical characteristics of interfaces and medium ○ Representation of bits ○ Data rate ○ Synchronization of bits ○ Line configuration ○ Physical topology ○ Transmission mode.	2		15
	• **Data link Layer** ○ Framing ○ Physical addressing ○ Flow control ○ Error control ○ Access control	2		
	• **Network Layer** ○ Logical addressing ○ Routing	1		
	• **Transport Layer** ○ Service-point addressing ○ Segmentation and reassembly ○ Connection control ○ Flow control ○ Error control	2		
	• **Session Layer** ○ Dialog control ○ Synchronization	1		

	• **Presentation Layer**
	  ○ **Translation**
	  ○ **Encryption**
	  ○ **Compression**
	
	• **Application Layer**
	  ○ **Network virtual terminal**
	  ○ **File transfer, access, and management**
	  ○ **Mail services**
	  ○ **Directory services**
		2
		
		2		

V a)	• Attenuation
	  ○ Loss of energy
	  ○ When a signal, simple or composite, travels through a medium, it losses some of its energy in overcoming the resistance of the medium.
	
	• Distortion
	  ○ Signal changes its form or shape.
	  ○ Can occur in a composite signal made of different frequencies.
	  ○ Signal components at the receiver have phases different from what they had at the sender. The shape of the composite signal is therefore not the same.
	
	• Noise
	  ○ Several types of noise - Thermal, induced, crosstalk and impulse
	  ○ Thermal Noise - Random motion of electrons in a wire which creates an extra signal not originally sent by the transmitter.
	  ○ Induced Noise - Comes from sources such as motors and appliances.These devices act as a sending antenna and the transmission medium acts as a receiving antenna.
	  ○ Crosstalk - The effect of one wire on the other.One wire acts as a sending antenna and the other as a receiving antenna.
	  ○ Impulse Noise - Is a spike that comes from power lines, lightning, etc.
		2
		
		2
		
		2
			6	15

V b)	Diagram  	3		
	• Sampling o Analog signal is sampled every T_s second, where T_s is the sample interval or period. o The inverse of the sampling interval is called the sampling rate or sampling frequency, denoted by $f_s = 1/T_s$ o Three sampling methods – Ideal, Natural, Flat-top	2		
	• Quantization o The result of sampling is a series of pulses with amplitude values between the maximum and minimum amplitude values of the signal. o The set of amplitudes can be infinite with non integral values between the two limits. o These values can not be used in the encoding process o Steps in quantization: 1. We assume that the original analog signal has instantaneous amplitudes between V_{min} and V_{max}. 2. We divide the range into L zones, each of height Δ (delta). $$\Delta = \frac{V_{max} - V_{min}}{L}$$ 3. We assign quantized values of 0 to $L - 1$ to the midpoint of each zone. 4. We approximate the value of the sample amplitude to the quantized values.	2	9	
	• Encoding o After each sample is quantized and the number of bits per sample is decided, each sample can be changed to n_b bit code. o The number of bits for each sample is determined from	2		

	the number of quantization levels. ○ If the number of quantization level is L, the number of bits is $n_b = \text{Log}_2 L$			
VI a)	• Frequency of the carrier signal is modulated to follow the changing voltage level (amplitude) of the modulating signal. • Peak amplitude and phase remain same. • As Figure shows, FM is normally implemented by using a voltage-controlled oscillator as with FSK.The frequency of the oscillator changes according to the input voltage which is the amplitude of the modulating signal. 	1 1 1 3	6	
VI b)	• FDM ○ Applied when the bandwidth of a link is greater than the combined bandwidth of the signals to be transmitted. ○ Signals generated by each sending device modulate different carrier frequencies. ○ The modulates signals combined into a single composite signal ○ Multiplexing and demultiplexing techniques ○ An analog multiplexing technique that combines analog signals (Any Three) • TDM ○ TDM is a digital process that allows several connections to share the high bandwidth of a link. ○ Instead of sharing portion of bandwidth, time is shared. ○ Each connection occupies a portion of time in the link.	3	9	15

	○ TDM is a digital multiplexing technique for combining several low-rate channels into one high-rate one. (Any Three) • WDM ○ Designed to use high data rate capacity of fiber optic cable. ○ WDM is conceptually same as FDM ○ In WDM, multiplexing and demultiplexing involve optical signals transmitted through fiber optic channels. ○ Multiplexing and demultiplexing (Any Three)	3 3		
VII a)	• Twisted-pair cable use metallic (copper) conductors that accept and transport signals in the form of electric current. • Consists of two conductors (normally copper), each with its own plastic insulation, twisted together. • One of the wire is used to carry signals to the receiver, and the other is used as a ground reference. • Receiver uses the difference between the two. • Twisting makes it probable that both wires are equally affected by external influences. • Receiver, calculates the difference between two, receives no unwanted signals.	1 1 1 1 1 1	6	15
VII b)	• Carries signals of higher frequency ranges than those in twisted-pair cable. • Coax has a central core conductor of solid or stranded wire (usually copper) enclosed in an insulating sheath, which is, in turn , encased in an outer conductor of metal foil, braid, or a combination of the two. • The outer metallic wrapping serves both as a shield against noise and as the second conductor, which completes the circuit. • The outer conductor is also enclosed in an insulating sheath, and the whole cable is protected by a plastic cover. • BNC Connector • BNC T Connector • BNC Terminator	1½ 1½ 1½ 1½ 1 1 1		

VIII	**Radio Waves**
	• Electromagnetic waves ranging in frequencies between 3kHz and 1GHz are normally called radio waves.
	• Radio waves are omnidirectional.
	• Use omnidirectional antennas that send out signals in all directions.
	• Antenna transmits radio waves, they are propagated in all directions.
	• Sending and receiving antennas do not have to be aligned.
	  • A sending antenna sends waves that can be received by any receiving antenna.
	• The omnidirectional property has a disadvantage: The radio waves transmitted by one antenna are susceptible to interference by another antenna that may send signals using the same frequency or band.
	• Radio waves that propagate in the sky mode can travel long distances.
	• Radio waves of low and medium frequencies can penetrate walls.
	  • Advantage, because signals can receive inside a building.
	  • Disadvantage, we cannot isolate a communication to just inside or outside a building.
	• The radio wave band is relatively narrow, just under 1GHz. When this band is divided into sub bands, the sub bands are also narrow, leading to a low data rate for digital communications.
	• Using any part of the band requires permission from the authorities.
	(Any Five)
	Micro Waves
	• Having frequencies between 1 and 300 GHz are called microwaves.
	• They are unidirectional.
	• When an antenna transmits microwave waves, they can be narrowly focused.
	• The sending and receiving antennas need to be aligned.
	• A pair of antennas can be aligned without interfering with
		5		15

	another pair of antennas. • Microwave propagation is line-of-sight. So the towers that are far apart need to be very tall. Repeaters are needed for long distance communication. • Very high frequency microwaves cannot penetrate walls. This is a disadvantage if receivers are inside buildings. • The microwave band is very wide. Therefore wider sub bands can be assigned and a high data rate is possible. (Any Five) **Infrared Waves** • Frequencies from 300GHz to 400THz (wavelength 1mm to 770nm) • Infrared waves with high frequencies cannot penetrate walls. • Prevents interference between one system and other, a short-range communication system in one room cannot be affected by another system in the next room. • However this makes infrared signals useless for long range communication. • In addition, we cannot use infrared waves outside a building because the sun's rays contain infrared waves that can interfere with the communication. • Infrared can be used to transmit digital data with a very high data rate. • The Infrared Data Association (IrDA) has established standards for using these signals for communication. (Any Five)	5 5		
IX a)	**Cyclic Redundancy Check**: Cyclic codes called the cyclic redundancy check (CRC) that is used in networks such as LANs and WANs. In the encoder, the dataword has k bits (4 here); the codeword has n bits (7 here).The size of the dataword is augmented by adding n - k (3 here) Os to the right-hand side of the word. The n-bit result is fed into the generator. The generator uses a divisor of size n - k + I (4 here), predefined and agreed upon. The generator divides the augmented dataword by the divisor (modulo-2 division). The quotient ofthe division is discarded; the remainder (r2rl ro) is appended to the dataword to create the codeword.	2	6	15

	The decoder receives the possibly corrupted codeword. A copy of all n bits is fed to the checker which is a replica of the generator. The remainder produced by the checker is a syndrome of n - k (3 here) bits, which is fed to the decision logic analyzer. The analyzer has a simple function. If the syndrome bits are all as, the 4 leftmost bits of the codeword are accepted as the dataword (interpreted as no error); otherwise, the 4 bits are discarded (error). **Encoder**: The encoder takes the dataword and augments it with n - k number of as. It then divides the augmented dataword by the divisor. **Decoder**: The codeword can change during transmission. The decoder does the same division process as the encoder. The remainder of the division is the syndrome. If the syndrome is all Os, there is no error; the dataword is separated from the received codeword and accepted. Otherwise, everything is discarded.	2 1 1		
IX b)	**HDLC:** High-level Data Link Control (HDLC) is a bit-oriented protocol for communication over point-to-point and multipoint links. HDLC provides two common transfer modes that can be used in different configurations: 1) Normal response mode (NRM) 2) Asynchronous balanced mode (ABM). Each frame in HDLC may contain upto six fileds: • Beginning flag field • Address field • Control field • Information field • Frame check sequence (FCS) • Ending flag field HDLC Frame format	2 2 3 2	9	
X	• Listing • Description o ALOHA o Pure ALOHA o Slotted ALOHA o CSMA – I Persistent, Non Persistent o CSMA o CSMA/CD	3 3 2 2 3 1 1	15	15