Reg. No.

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL
(A constituent unit of MAHE, Manipal)

III SEMESTER B.TECH. (INFORMATION TECHNOLOGY)

MAKE UP EXAMINATIONS, DECEMBER 2018

SUBJECT: PRINCIPLES OF DATA COMMUNICATION [ICT 2104]

REVISED CREDIT SYSTEM
(31/12/2018)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data, if any, may be suitably assumed.

1A. Derive an expression for the Utilization factor in the case of Stop-and-Wait Flow control. Given "a", the ratio of propagation time with transmission time, Obtain the relation between the length of the link in bits and length of the transmission frame. If the normalized transmission time for transmitter is one (1), show the timing diagram depicting total transmission time of one frame for the cases a>1 and a<1. **5**

1B. Given a PN sequence of 1000 and input binary data of 10000011 show the frequency assignment diagram with respect to time for the various frequencies of FHSS. The carrier frequency provided is 475 kHz and the difference frequency 25 kHz. Find out with what frequency range each of these signals are sent. **3**

1C. Two stations communicate via a 1-Mbps satellite link with a propagation delay of 270 ms. The satellite serves merely to retransmit data received from one station to another, with negligible switching delay. Using HDLC frames of 1024 bits with 3-bit sequence numbers, what is the maximum possible data throughput of data bits carried in HDLC frames? **2**

2A. Give the Hamming pairwise distance among the code words 000000, 010101, 101010, 110110. If these code words were itself the data, compute the parity bits needed to be added so that it forms a Hamming code. How many bit errors can be detected and corrected in both the cases? If the LSB (the right most bit of the data) is in error which parity bits are affected? **5**

2B. Given a packet of size 20 octets with 3 octets as additional control information, show the effect of packet size reduction on transmission time when the packet of size 20 octet is split into smaller size of 10, 5 and 2.5 octets and transmitted with three hops from 'W' to 'X' to 'Y' to 'Z' using packet switching technique. **3**

2C. Twenty-four voice signals with 4 kHz per signal are to be multiplexed and transmitted over twisted pair. With PCM each voice signal requires a data rate of 64 kbps. Given the bandwidth efficiency of 1 bps/Hz, what is the bandwidth required for TDM using PCM? What is the bandwidth required for FDM? **2**

3A. Explain with relevant example the usage of data link control on TDM channels. Two analog source each of 1 kHz bandwidth is passed through a 2 bit A/D convertor which is combined with two digital source of 3.8 kbps. Illustrate with relevant diagram, the combined TDM pulse output signal. **5**

3B. Given the earth's radius as 6370km, derive the expression for the distance between the antenna horizon and the antenna height. **3**

3C. The received signal level for a particular digital system is -115 dBm and the receiver system effective noise temperature is 1400K,

i. Calculate E_b/N_0 for a link transmitting 300 bytes per second.

ii. Give the effect on transmission bandwidth, if E_b/N_0 is doubled. **2**

4A. Phase Shift Keying maps the binary information to certain phase difference in the output signal. If the information bits are 00, the phase change is $\pi/4$, for 01 it is $3\pi/4$, for 10 it is $-3\pi/4$ and for 11 it is $-\pi/4$. Plot the modulated phases of the signal elements for the input 010010110001 using QPSK and OQPSK. Interpret which method has more advantages. **5**

4B. Explain the following modes of propagation with respect to Optical Fiber communication:

i. Single mode

ii. Step-index multimode

iii. Graded-index mode **3**

4C. Consider the angle-modulated signal $s(t) = 10\cos[2\pi(10^6)t + 0.1\sin(10^3)\pi t]$

i. Express $s(t)$ as a PM signal with $n_p = 10$

ii. Express $s(t)$ as an FM signal with $n_f = 10\pi$ **2**

5A. With a neat block diagram, explain delta modulation technique. Provide example to substantiate this. **5**

5B. Suppose a transmitter produces 50 W of power.

i. Express the transmit power in units of dBm.

ii. If the transmitter's power is applied to a unity gain antenna with a 900 MHz carrier frequency, what is the received power in dBm at a free space distance of 100 m?

iii. If gain of receiver antenna is 2 and carrier frequency is 600 MHz, what is the received power in dBm at a free space distance of 200 m? **3**

5C. For a 12 – bit binary string 010011000110, calculate the number of transitions for bipolar AMI and Manchester encoding schemes. **2**