Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

III SEMESTER B.TECH. (INFORMATION TECHNOLOGY)

END SEMESTER EXAMINATION, NOVEMBER 2018

SUBJECT: PRINCIPLES OF DATA COMMUNICATION [ICT 2104]

REVISED CREDIT SYSTEM
(29/11/2018)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

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

1A. Give the frame format for the HDLC frame along with extended address field and control field. Explain the different types of stations, link configurations and transfer mode. Illustrate with vertical time line diagrams the three phases of HDLC operations. **5**

1B. Given the code for user A as <1,-1,-1,1,-1,1> for B as <1,1,-1,-1,1,1> and C as <1,1,-1,1,1,-1>. If the data of 1(one) is sent from both B and C at the sender. Is it possible to recover the message at the receiver end B using the CDMA concept? **3**

1C. A channel has a data rate of R bps and a propagation delay of t s. for every km. The distance between the sending and receiving nodes is L kilometers. Nodes exchange fixed-size frames of B bits. Find a formula that gives the minimum sequence field size of the frame as a function of R, t, B, and L. (considering maximum utilization). Assume that ACK frames are negligible in size and the processing at the nodes is instantaneous. **2**

2A. A CRC is constructed to generate a 4-bit FCS for an 11-bit message. The generator polynomial is x^4+x^3+1. **5**
i. Draw the shift register circuit that would perform this task.
ii. Encode the data bit sequence 10011011100 (leftmost bit is the least significant) using the generator polynomial and give the codeword.
iii. Now assume that bit 7 (counting from the LSB) in the codeword is in error and check if it is possible to detect the error by modulo two arithmetic.

2B. What is the disadvantage of space division switch? Show how is it overcome in multi-stage switch? What are the problems associated with this multiple-stage switch? **3**

2C. Ten 9600 bps lines are to be multiplexed using TDM. Ignoring overhead bits in the TDM frame, what is the total capacity required for synchronous TDM? Assuming that we wish to limit average TDM link utilization to 0.8, and assuming that each TDM link is busy 50% of the time, what is the capacity required for statistical TDM? **2**

3A. "Be Happy Now" is the message which has to be multiplexed. Show all the variations of multiplexing to send this data using three sources. What is the ratio of the total multiplexed line capacity to the total maximum input, if the features of all the input sources are the same and is shared with full capacity equally among them? **5**

3B. Explain OQPSK with a neat diagram and also write the difference between QPSK and OQPSK. **3**

3C. The communication between two satellites obeys the free space law. The signal is too weak. The vendor offers two options. The vendor can use a higher frequency that is twice the current frequency or can double the effective area of both of the antennas. If all other factors remain equal, which option will offer more received power or will both offer the same improvement,? How much improvement in the received power do you obtain from the best option? **2**

4A. Suppose that a digitized TV picture is to be transmitted from a source that uses a matrix of picture elements (pixels), where each pixel can take one of 32 intensity values. Assume that 30 pictures are sent per second. **5**

i. Find the source rate R (bps).
ii. Assume that the TV picture is to be transmitted over a channel with 4.5 MHz bandwidth and a 35 dB signal-to-noise ratio. Find the capacity of the channel (bps).
iii. Discuss how the parameters given in part (i) could be modified to allow transmission of color TV signals without increasing the required value for R.

4B. A microwave transmitter has an output of 0.2 W at 2 GHz. Assume that this transmitter is used in a microwave communication system where the transmitting and receiving antennas are parabolas, each 1.4 m in diameter. **3**

i. What is the gain of each antenna in decibels?
ii. Taking into account antenna gain, what is the effective radiated power of the transmitted signal?
iii. If the receiving antenna is located 20 km from the transmitting antenna over a free space path, find the available signal power out of the receiving antenna in dBm units.

4C. Explain the following transmission impairments: **2**

i. Delay Distortion
ii. Intermodulation noise

5A. With a neat block diagram explain PCM modulation technique. Discuss the use of non-linear encoding and companding in PCM. **5**

5B. For the input digital data stream 1011100111, sketch the waveforms for NRZ-L, Bipolar-AMI and Manchester signal encoding methods. The most recent preceding 1 bit for Bipolar-AMI has a positive voltage. **3**

5C. Suppose the spectrum of a channel is between 3 MHz and 4 MHz and $SNR_{dB} = 24$, what is the capacity of the channel? Calculate the signaling levels required to achieve this capacity. **2**