Reg. No.

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

III SEMESTER B.TECH. (COMPUTER AND COMMUNICATION ENGINEERING)

END SEMESTER EXAMINATIONS, NOVEMBER 2017

DIGITAL COMMUNICATION [ICT 2152]

REVISED CREDIT SYSTEM

(25/11/2017)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

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

1A. With a neat block diagram explain PCM modulation technique. Discuss the use of non-linear encoding and companding in PCM. 5

1B. Explain the following modes of propagation with respect to optical Fiber communication:

i. Single mode
ii. Step-index multimode
iii. Graded-index mode 3

1C. Derive an expression that relates the spectral efficiency to the ratio of signal energy per bit to noise power density per Hertz. Given a channel with an intended capacity of 20 Mbps, the bandwidth of the channel is 3 MHz. Assuming white noise, what signal-to-noise ratio is required to achieve this capacity? 2

2A. A CRC is constructed for a 12-bit data 1 0 0 1 1 1 1 0 0 1 0 1 using the generator polynomial $X^4 + X^3 + 1$. Generate the FCS using polynomial method. Give the transmitted code word. If channel introduces an error pattern $X^8 + X^7 + X^6 + 1$, find the received pattern and validate using modulo-2 arithmetic. 5

2B. The frames are generated at node A and sent to node C through node B. The distance between node A and node B is 4000km and the distance between node B and node C is 1000km. Determine the minimum data rate required between nodes B and C so that the buffers of node B are not flooded, based on the following:

i. The data rate between A and B is 100 kbps.
ii. The propagation delay is 5μs/km for both lines.
iii. There are full duplex lines between the nodes.
iv. All data frames are 1000 bits long
v. ACK frames are separate frames of negligible length.
vi. Between A and B, a sliding-window protocol with a window size of 3 is used.
vii. Between B and C, stop-and-wait is used.
viii. There are no errors. 3

2C. Explain CDMA for direct sequence spread spectrum with a neat diagram. 2

3A. Explain Frequency-hopping spread spectrum with necessary expressions and neat block diagrams of transmitter and receiver. 5

3B. For the input digital data stream 1101100111, sketch the waveforms for NRZ-L, Bipolar-AMI, Manchester signal encoding methods. The most recent preceding 0 bit for Bipolar-AMI has a positive voltage. 3

3C. Explain select and poll functions in polling access method. 2

4A. With a neat block diagram of transmitter and receiver, explain the concept of frequency division multiplexing technique. Explain analog carrier systems. 5

4B. Explain how synchronization is achieved using asynchronous and synchronous transmission. 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. Two nodes A and B make use of HDLC protocol for data transmission. If selective reject ARQ is used with 3 bit sequence number, what is the window size? Give a neat vertical time sequence diagram for the following scenarios:

i. A initializes and B acknowledges
ii. A transmits first three data frames
iii. B transmits its first two data frames once it receives second frame from A but before the reception of third frame.
iv. Third frame sent by A is damaged frame and B rejects the same
v. Reject is lost, assuming A is not sending other frames. Give timeout scenario at A
vi. B responds and A resumes with two frames
vii. B does not have data frames to send but need to acknowledge
viii. A initiates for disconnect, B acknowledges 5

5B. 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.

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. 3

5C. Differentiate datagram and virtual circuit approach in packet switching technique. 2