PRINCE OF SONGKLA UNIVERSITY

FACULTY OF ENGINEERING

Final Examination: Semester II   Academic Year: 2013

Date: 3 March 2014   Time: 09.00-11.00

Subject: 241-360 Introduction to Communication Systems and Networks   Room: S104

1. ข้อสอบมี 2 ตอน: Part One และ Part Two

2. ข้อสอบใน Part One มี 24 ข้อ ใน Part Two มี 15 ข้อ

3. ไม่อนุญาตให้นำเครื่องคิดเลขหรือเครื่องอิเล็กทรอนิกส์ทุกชนิดเข้าห้องสอบ

4. ไม่อนุญาตเอกสารหรือตำราทุกชนิด

ทุจริตในการสอบ โทษขั้นต่ำคือ ปรับตกในรายวิชาที่ทุจริต และพักการเรียน 1 ภาคการศึกษา

Part One

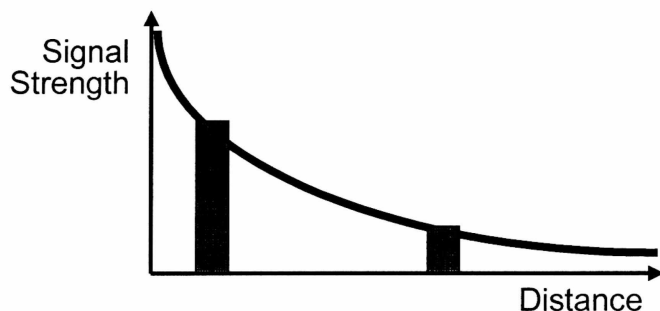| |
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Part Two

1	2	3	4	5	6	7	8

9	10	11	12	13	14	15	Total

Part One:

Each question has 2 marks if you select the correct answer. However, minus one (-1) will be marked if you select incorrect answer. However, there is no penalty mark (or negative mark) if you leave your answer blank (or no answer selected).

1. What is the cause called?
   a) Attenuation
   b) Distortion
   c) Propagation
   d) Phase shift
   e) No correct answer
2. What is the cause called?
   Amplitude
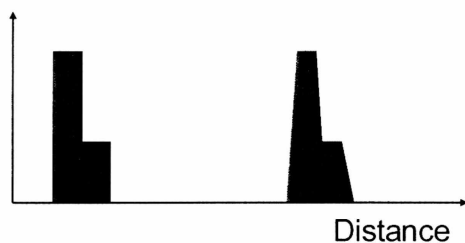
   a) Attenuation
   b) Distortion
   c) Propagation
   d) Phase shift
   e) No correct answer
3. Which one is NOT true?
   a) A simplex channel is unidirectional, which means data can only be sent in one direction.
   b) A half-duplex channel allows information to flow in either direction (but not simultaneously).
   c) A full-duplex channel allows data to be sent in both directions simultaneously.
   d) A full-duplex can be constructed by using 2 simplex channels.
   e) No correct answer.
4. Which one is different from others?
   a) Coaxial, Twisted pair (UTP), Shielded twisted pair (STP)
   b) Coaxial, Twisted pair (UTP), Fiber optic

    c) Microwave, Satellite, Fiber optic

    d) Infrared, Microwave, Radio.

    e) Microwave, Radio, Satellite

5. Which one is NOT advantage of using fiber optic

    a) Very low attenuation

    b) Noise immunity

    c) Extremely high bandwidth

    d) Difficult to splice

    e) No corrosion

6. What is the cause of "fading"?

    a) Multipath propagation

    b) Interference from other users

    c) Modulation problem

    d) Carrier signal lost

    e) Attenuation

7. Which one is NOT advantage of synchronous transmission?

    a) Low overhead

    b) Large blocks of bits transmitted

    c) Used at higher speeds than asynchronous

    d) A loss of synchronization

    e) All of above

8. Select the correct answer
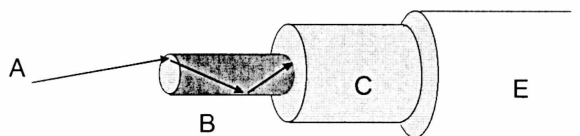
    a) A = Core, B = Light, C = Jacket, E = Cladding

    b) A = Light, B = Cladding, C = Jacket, E = Core

    c) A = Light, B = Cladding, C = Core, E = Jacket

    d) A = Light, B = Core , C = Cladding, E = Jacket

    e) No correct answer

9. What is "X"?
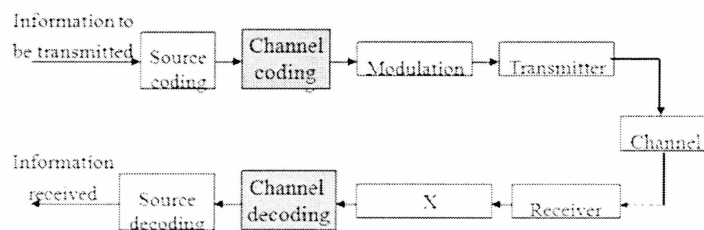
    a) Modulation

    b) Demodulation

    c) Encoder

d) Decoder

e) Band-pass filter

10. What kind of multiplexing technique used in the below picture?
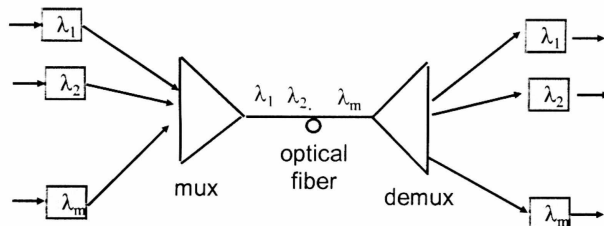
a) TDM

b) FDM

c) WDM

d) SDM

e) No correct answer

11. Which one is incorrect for FDM (frequency Division Multiplexing)?

a) FDM cannot utilise the full capacity of the link

b) FDM need a gap between the frequency bands

c) FDM is usually used to carry analouge signals

d) FDM is usually used statistical multiplexing technique

e) FDM is usually used band-pass filter

12. Which one is the most efficient multiplexing technique?

a) Frequency Division Multiplexing

b) Synchronous Time Division Multiplexing

c) Statistical Time Division Multiplexing

d) Asynchronous Time Division Multiplexing

e) Wavelength Division Multiplexing

13. Which one is TRUE for WDM?

a) Wavelength Division Multiplexing is TDM

b) Wavelength Division Multiplexing uses base-band frequency

c) Wavelength Division Multiplexing uses laser to transmit light at different frequencies

d) Wavelength Division Multiplexing can only be used in single mode optic fiber

e) Wavelength Division Multiplexing is better than Dense WDM

14. Below is DWDM. Each wave length carries 10 Gbps of information. What is the capacity of the link?
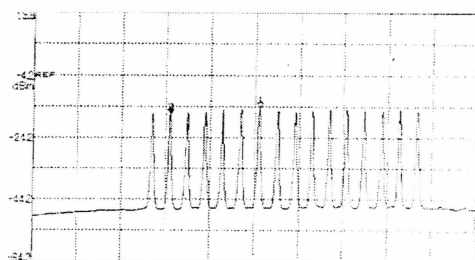
a) 10 Gbps

b) 16 Gbps

c) 160 Gbps

d) 200 Gbps

e) 1 Tbps

15. Which one is NOT true for TDM?
    a) Time slots are pre-assigned to sources
    b) Time slots are allocated even if there is no data
    c) The sequence of slots assigned to a source is called a channel.
    d) The slot length equals the transmitter buffer size, typically, one bit or one character.
    e) Bit interleaving is used with asynchronous sources.

16. Which one does characterise "Statistical Multiplexing"?
    a) Traffic is sent on demand, so channel is fully utilized if there is enough demand
    b) Any number of flows
    c) Need to control sharing:
    d) Resources are not guaranteed
    e) All of the above

17. Which one does characterise TDM?
    a) TDM may under utilize channel with idle senders
    b) Applicable only to fixed number of flows
    c) Requires precise timer (or oscillator and guard bands for FDM)
    d) Resources are guaranteed
    e) All of the above

18. Which one is true?
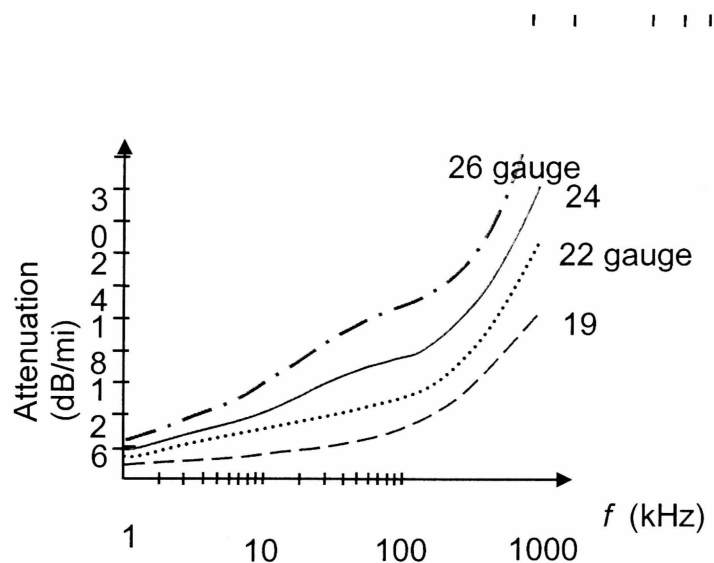
    a) Higher gauge number, higher attenuation
    b) Lower gauge number, higher frequency
    c) 19 gauge cable gives a longer distance than others
    d) At 100 kHz frequency, 22 gauge cable has a lower attenuation than 26 gauge cable
    e) All are correct.

19. Which one can give the highest bandwidth?
    a) Twisted pair (UTP)
    b) Shielded twisted pair (STP)
    c) Fiber optic
    d) Infrared

e) Microwave

20. Which point is the best for fiber optic to use?
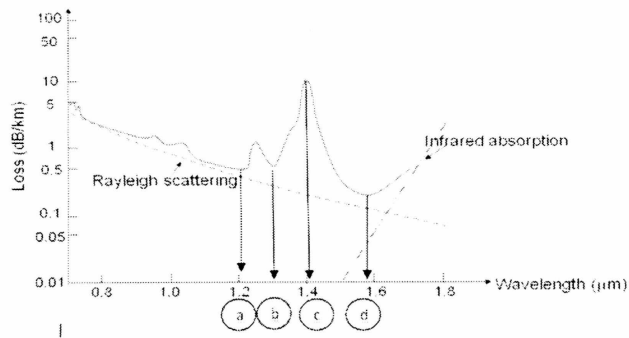
21. What kind of multiplexing used by the below scheme?
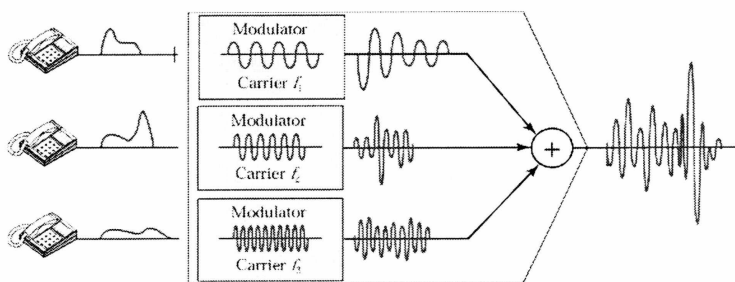
- a) FDM
- b) TDM
- c) SDM
- d) CDM
- e) No correct answer

22. Which one is the advantage of WDM (Wave Division MUX)
- a) can be used for twisted-pair
- b) can be used with TDM switch
- c) give more channels than TDM and FM
- d) has a lower attenuation than TDM and FM
- e) all are correct.

23. What is the cause of this figure?
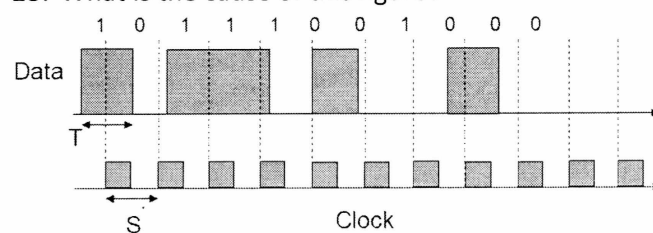
- a) synchronization
- b) multiplexing
- c) attenuation

d) data loss

e) no correction answer

24. Which one is disadvantage of using circuit switch?

    a) inefficient use of the transmission media

    b) low utilization

    c) no dynamic BW

    d) long connection delays

    e) All of above

25. Which one is advantage of using packet switching?

    a) improves the use of bandwidth over circuit switching

    b) can adjust routes to reflect network conditions

    c) shorter transmission delays than message switching

    d) less disk space

    e) All of above

26. What is a communication network given below?
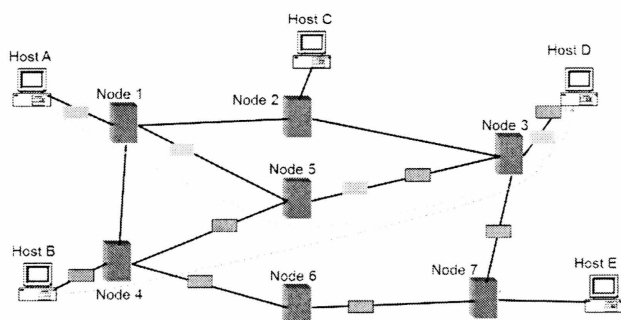
    a) Datagram packet switching

    b) Virtual circuit switching

    c) Circuit switching

    d) Time division switching

    e) No correct answer

27. Four 1-kbps connections are multiplexed together. A unit is 1 bit. Find the duration of 1 bit before multiplexing.

    a) 10 ms

    b) 5 ms

    c) 1 ms

    d) 0.5 ms

    e) No correct answer

Part Two:

1. Consider asynchronous transmission in the form of 8-bit characters with one start bit and 2 stop bits. For a 100 kbps link, let the sampling instants at the receiver be in the middle of each bit. What is the maximum tolerance of the alignment between the transmitter and receiver clocks for correct reception of character on this line? (10 marks)
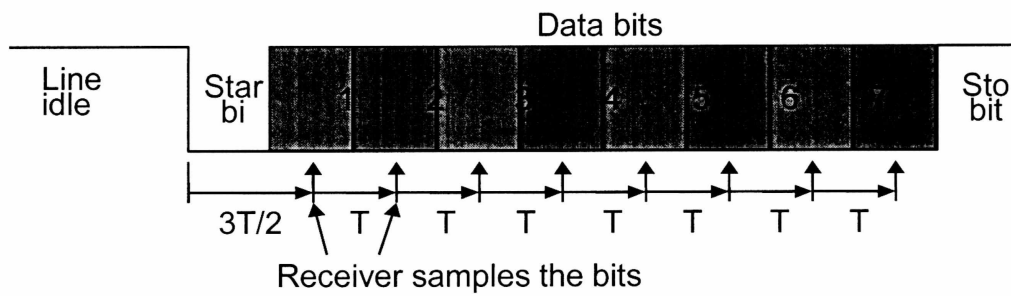
Figure 1

Answer:

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2. We have 8 sources, each creating 500 characters per second. If the interleaved unit is a character and 1 synchronizing bit is added to each frame, find (a) the data rate of each source, (b) the duration of each character in each source, (c) the frame rate, (d) the duration

of each frame, (e) the number of bits in each frame, and (f) the data rate of the link. (12 marks)

Answer:

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3. Four channels are multiplexed using TDM. If each channel sends 200 bytes/s and we multiplex two bytes per channel (a unit = 2 bytes), If 1 synchronizing bit is added to each frame, please find (12 marks)

   a. The bit rate of each source.
   b. The duration of each bit in each source.
   c. The frame rate.
   d. The duration of each frame.
   e. The number of bits in each frame.
   f. The bit rate of the link.

Answer

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3   From the picture given below, please calculate the out link capacity (5 marks)

Number of phones is 30, maximum voice bandwidth is 4 kHz, sampling rate is 8,000 samples/s while 8 bits is used for each sample.

Figure 2

Answer:

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4   Hamming Code can be applied for FEC (forward Error Correction) technique, as shown below

r_1 will take care of these bits.

11		9		7		5		3		1
d	d	d	r_8	d	d	d	r_4	d	r_2	r_1

r_2 will take care of these bits.

11	10			7	6			3	2	
d	d	d	r_8	d	d	d	r_4	d	r_2	r_1

r_4 will take care of these bits.

				7	6	5	4			
d	d	d	r_8	d	d	d	r_4	d	r_2	r_1

r_8 will take care of these bits.

11	10	9	8							
d	d	d	r_8	d	d	d	r_4	d	r_2	r_1

Figure 3 Redundant bit calculation using Hamming Code

a. If the original data is 1001101, what is the data code after using Hamming Code? (10 marks)

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b. If the following data is received by the receiver, 10010100101, is the data corrupted? If yes, what is bit number in error? (Please show your calculation) (10 marks)

Answer

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5   Assume that we are using two-dimensional parity check. If we use 'even parity' for this information transmitting, please fill in all parity check bits in the table below. (10 marks)

1	1	0	0	1	1	1	
1	0	1	1	1	0	1	
0	1	1	1	0	0	1	Row parities
0	1	0	1	0	0	1	

Column parities

Figure 4

Answer

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7. Suppose a message is sent and a single bit error occurs. What bit number is error in given below picture.

Bit positions:

Blue is parity bit

Red is bit number

Bit value in codeword:

Blue is parity bit

Black is data bit

Figure 5

Answer

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7. Below is a state diagram of Stop and Wait ARQ, please complete global state of (a), (b), (c), and (d). (10 Marks)

$$0 \quad 1 \quad 0 \quad 1 \quad 0 \quad 1 \quad 0 \quad 1$$

S_{last}

Timer

$$0 \quad 1 \quad 0 \quad 1 \quad 0 \quad 1 \quad 0 \quad 1$$

R_{next}

Transmitter A

S_{last}

Receiver B

R_{next}

Global State: (S_{last}, R_{next})

(a) — Error-free frame 0 arrives at receiver → (b)

ACK for frame 1 arrives at transmitter

ACK for frame 0 arrives at transmitter

(c) ← Error-free frame 1 arrives at receiver — (d)

Figure 6

Answer

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8. Use the figure below, which is Go-Back-N ARQ scheme, to answer the following questions (please try to give your reasons to support your answers): (10 Marks)
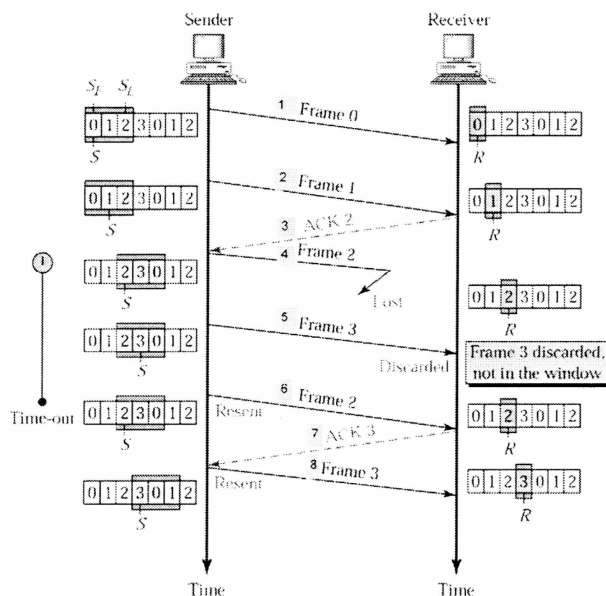
Figure 7 Go-Back-N operation

Answer the following questions for Go-Back-N ARQ: (10 Marks)

a. Why does the receiver not answer ACK of Frame 0 (step no. 1)? (2 marks)

Answer

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b. What happen if the receiver does not give ACK2 (step no. 3)? (2 marks)

Answer

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c. What happen if the receiver does not send ACK 3 (step no. 7)? (2 marks)

Answer

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d. In Go-Back-N ARQ, a window size must be less than a number of data unit in one block ($2^m - 1$). Why? (4 marks)

Answer

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9. The figure below is Selective Repeat ARQ. In this condition, window sizes (both sender and receiver) are greater than 2^{m-1} (Window size $> 2^{m-1}$). Please draw the receiving windows at the receiver at point (A), (B), (C), and (D). (10 marks)

Figure 8

Answer

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10. In a Stop-and-Wait ARQ system, the bandwidth of the line is 100 Mbps, and 1 bit takes 20 ms to make a round trip. Assume that all data are received correctly, e.g. no error and dropped.
    a. What is the bandwidth-delay product?
    b. If the system data frames are 1000 bits in length, how long does it take to transmit 10 Mbytes data? (10 Marks)
    c. If we want to have 100% of bandwidth utilization. What is the window size (in bits)?

Figure 9

Answer

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11. Suppose the following block of 16 bits is to be sent using a checksum of 8 bits. The receiver got the following binary stream: (10 Marks)

    10101001 00111001 00011101

The receiver is using internet check sum method to do error detection. Is this result okay to the receiver? What is the check sum value on the receiver side?

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12. Below is the flow diagram of Go-back-N ARQ with window size = 4. Please fill in all frame numbers (fr) in given square boxes, and R_{next} values in given square boxes (10 marks)
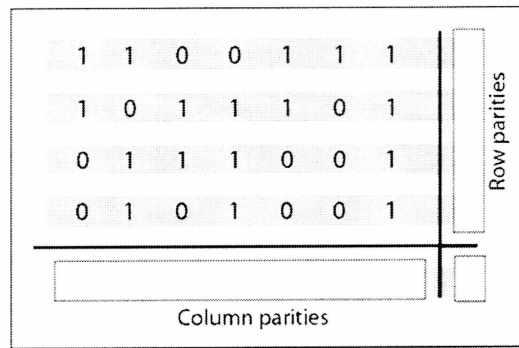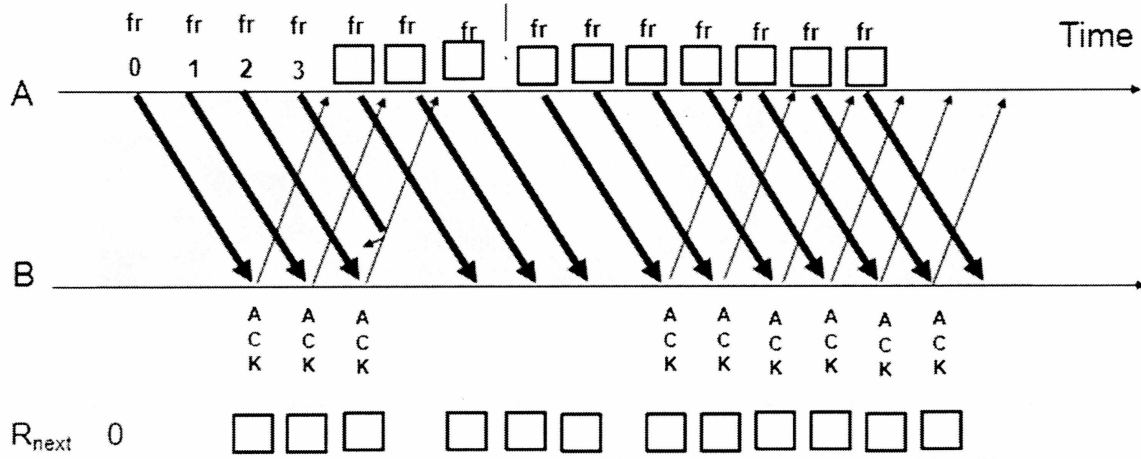
Figure 10

Answer

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13. Below is Selective Repeat ARQ Protocol with window size = 4. . Please fill in all frame numbers (fr) in given square boxes (10 marks)

fr	fr	fr	fr	fr	fr	fr	fr	fr	fr	fr	fr	fr	fr	Time
0	1	2	3	4										

A

B

	A	A		N	A	A	A	A	A	A	A	A	A
	C	C		A	C	C	C	C	C	C	C	C	C
	K	K		K	K	K	K	K	K	K	K	K	K
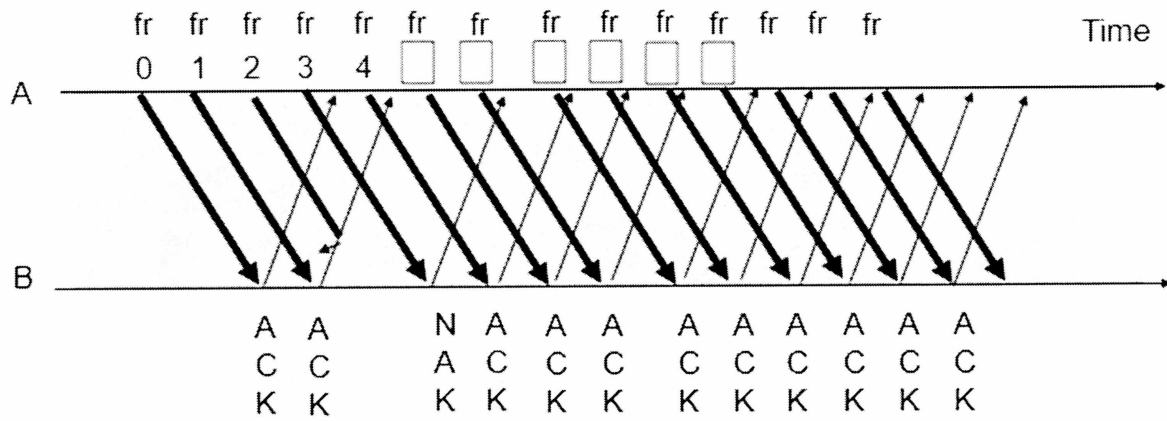
Figure 11

Answer

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14. A student sends binary data 1,1,0,1,0,0 to a lecturer using (9,6) Polynomial Coding for error detection. The process uses Generator Polynomial with g(x) = x^3+x+1. Please answer the following questions.

   a. What is Codeword from the student? (10 Marks)

Answer:

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Transmitted codeword: 110100<u>100</u>

b. At the receiver's end if the data are correct, please show how to verify it (10 Marks)

Answer:

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