Student Name: ..... Student ID.....Section .....

PRINCE OF SONGKLA UNIVERSITY

FACULTY OF ENGINEERING

Final Examination: Semester II Academic Year: 2014

Date: 10 May 2015 Time: 13.30-15.30

Subject: 242-214 การสื่อสารข้อมูล (Data Communications) Room: Robot

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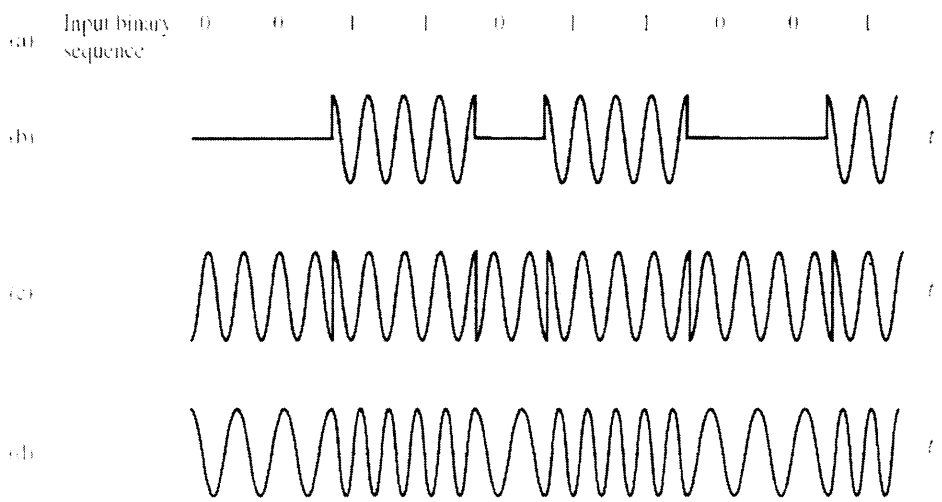
ทุจริตในการสอบ โทษขั้นต่ำคือ ปรับตกในรายวิชาที่ทุจริต และพักการเรียน 2 ภาคการศึกษา

Instruction:

1. Not allow all materials, e.g. books, notes, except writing tools, e.g. pens, pencils, erasers.
2. Not allow all types of electronic tools, e.g. dictionary, calculator, smart phone.
3. Total page: 21 (include this cover)

Analogue Transmission (60 marks)

1. From pictures below, please state that what modulation is used of each header (5 marks)



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Answer

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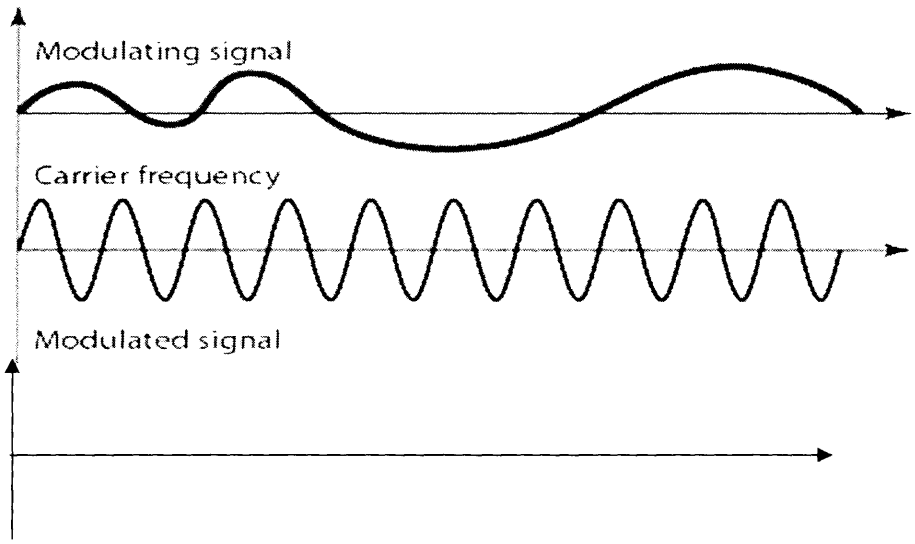
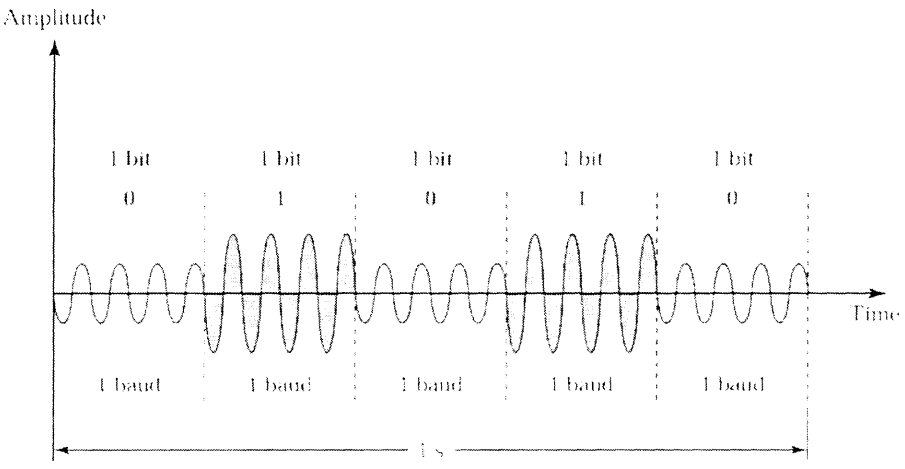
2. Draw a signal diagram of modulation signal by using AM (Amplitude Modulation) (5 marks)



3. Below is amplitude modulation, answer the following questions (10 marks)



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a) What is the baud rate?

b) What is the bit rate?

c) What is the bandwidth (in Hz) used in this modulation?

d) If we can use 2 Hz per bit, what bandwidth (in Hz) is required.

Answer

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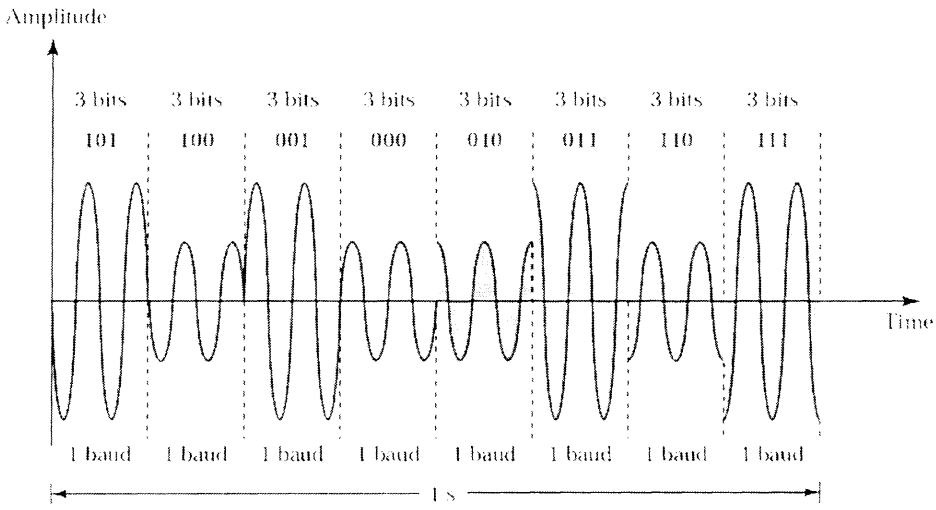
4. Below is QAM modulation, please answer the following questions (10 marks)



a) What is the baud rate?

b) What is the bit rate?

c) What is the bandwidth (in Hz) used in this modulation?

d) If we can use 3 Hz per baud and 10 bauds per sec, what bandwidth (in Hz) is required.

e) Draw the constellation diagram.

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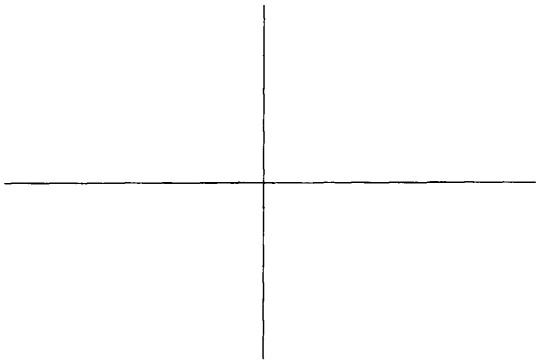
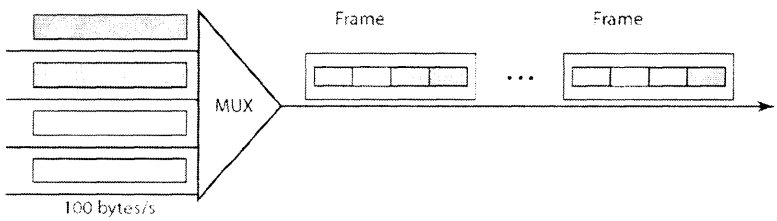


5. Four channels are multiplexed using TDM. If each channel sends 100 bytes /s and we multiplex 4 bits per channel, please determine: (10 marks)
    a) the size of the frame,
    b) the duration of a frame,
    c) the frame rate,
    d) the bit rate for the link.



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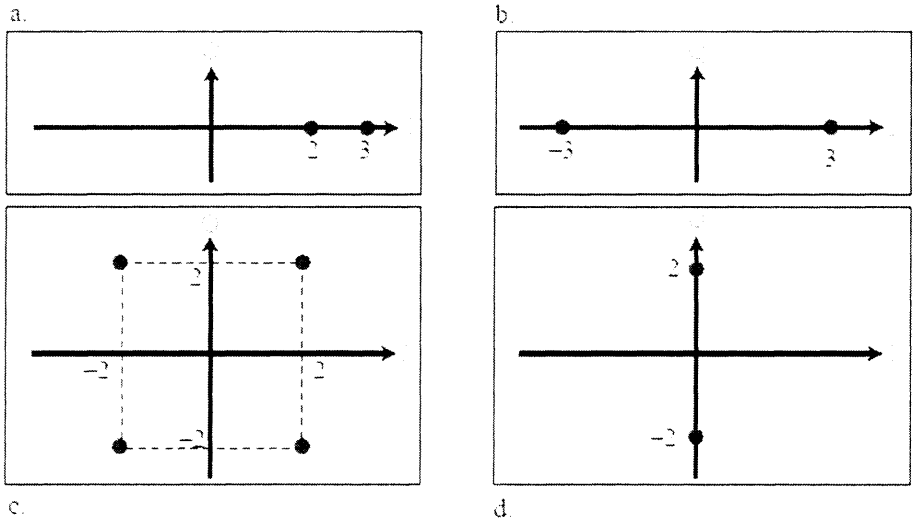
6. Below pictures are constellation diagrams, from diagram a to d, which help us to define the amplitude and phase of a signal. Please describe what modulation technique is used for each constellation diagram given below: (20 marks)



Answer

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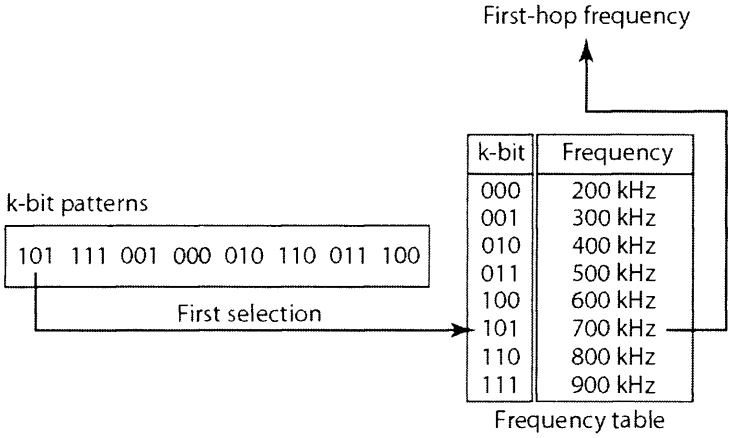
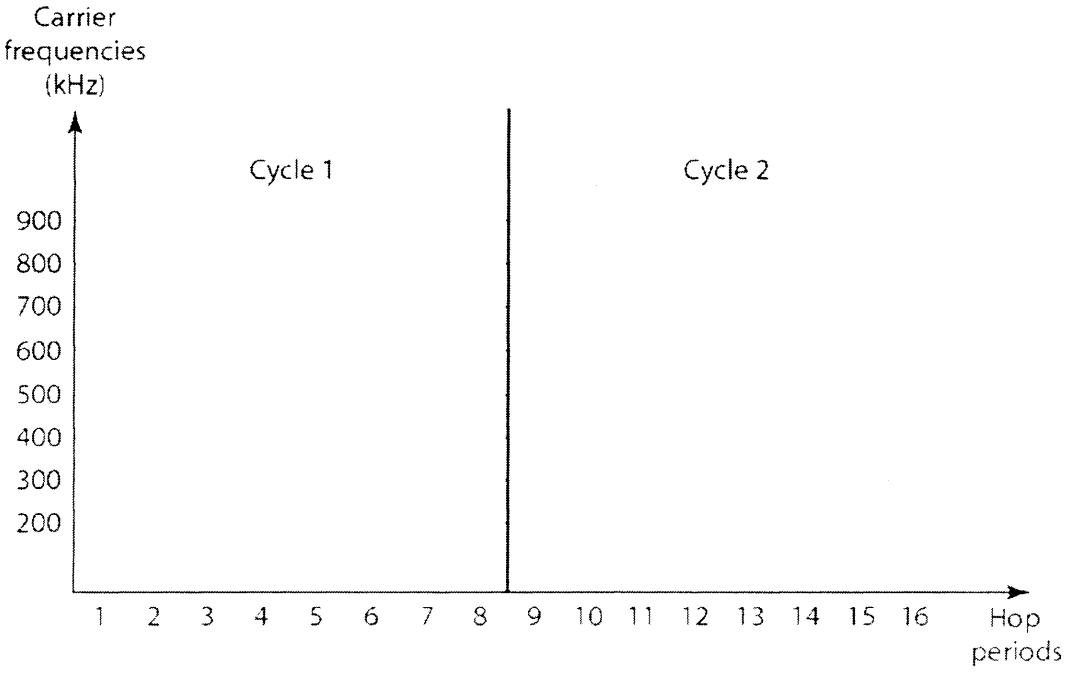
Bandwidth Utilisation (15 marks)

7. Below is Frequency selection in FHSS, please use the below k-bit patterns selection to draw the frequency hopping diagram (cycle 1 and cycle 2) (15 marks)



Answer



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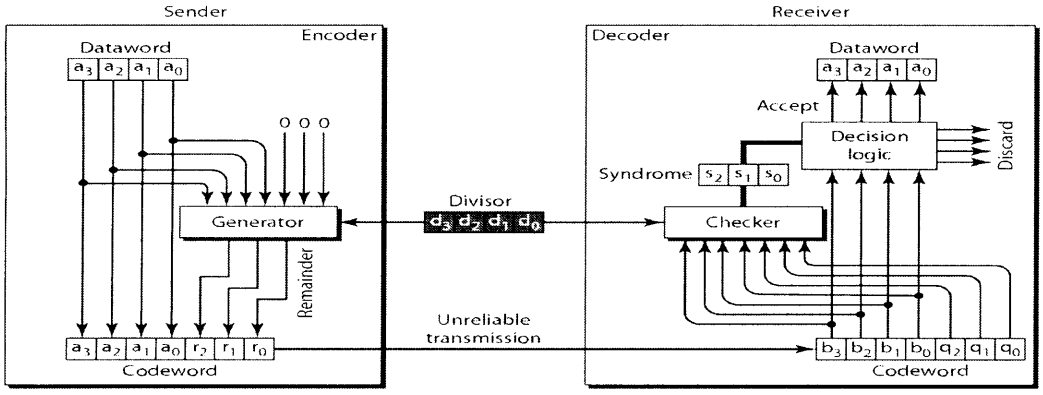
Error Detection and Correction (50 marks)

8. Below is CRC encoder and decoder scheme. If the divisor is 1011 and dataword is 1001,



a) What is the codeword to be sent out? (5 marks)

b) If the received code word is "1000 110", what is the syndrome? (5 marks)

Answer

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9. Below is a technique of column by column sending scheme. There is 4-bit burst error, and burst error correction is applied by using Hamming code. Please fill in all missing values of codewords received by the receiver. (10 marks)

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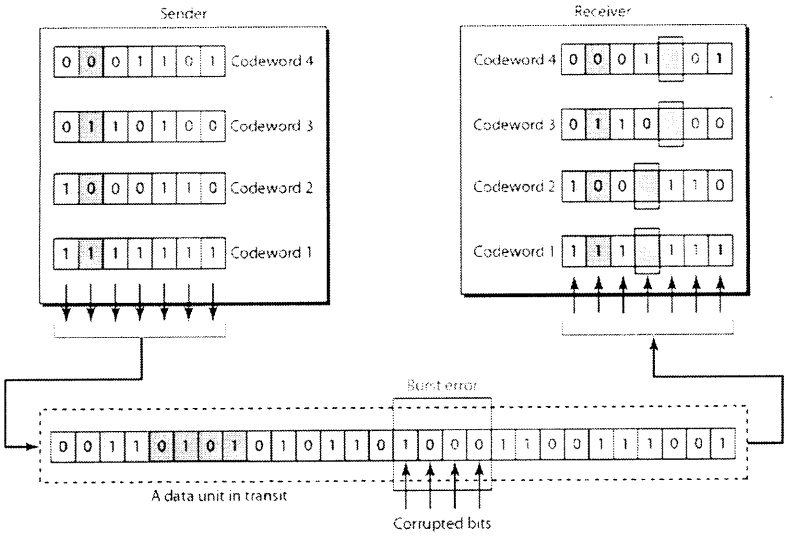

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10. Below is 2 dimensional parity bit checking, assume that all received parity bits are correct. There is "one bit" error received from the message. Please find which bit is error (circle on the error bit (10 marks)

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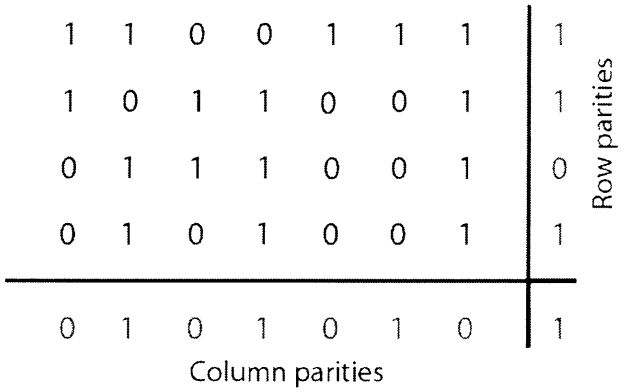
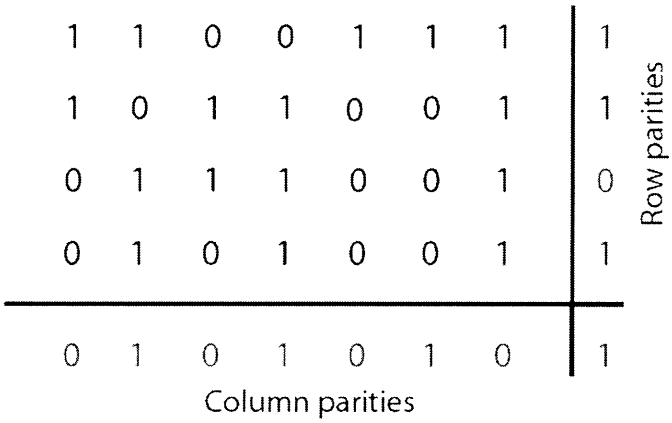


Answer
Please make the bit on this diagram.



** Show your calculation

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11. Below is checksum from the sender side. Please show checksum at the receiver side (10 marks)

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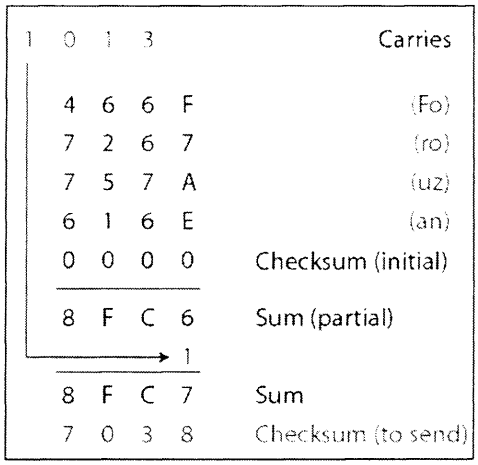

Answer

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12. Suppose a message is sent and a single bit error occurs, that the codeword 1110110 is received. If we use Hamming code checking scheme. What bit number is error in given below picture (show how you get the value). (10 marks)

7	6	5	4	3	2	1	
1	1	1	0	1	1	0	7-BIT CODEWORD
1	-	1	-	1	-	0	(EVEN PARITY)
1	1	-	-	1	1	-	(EVEN PARITY)
1	1	1	0	-	-	-	(EVEN PARITY)

Answer

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Multiplexing (70 marks)

13. (a) What is statistical multiplexing? (5 marks)
(b) Why does it differ from conventional multiplexing? (5 marks)
(c) What are the advantages of the statistical MUX compared to the convention MUX? (5 marks)

Answer

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14. (a) What is the difference between circuit switching and packet switching? (b) What are the advantages and disadvantages of packet switching (compared to circuit switching)? (10 marks)

15. Two offices are communicating using TDM; four 2-Kbps connections are multiplexed together. A unit is 1 bit. Find
    (a) the duration of 1 bit before multiplexing, (5 marks)
    (b) the transmission rate of the link, (5 marks)
    (c) the duration of a time slot, and (5 marks)
    (d) the duration of a frame? (5 marks)

Answer

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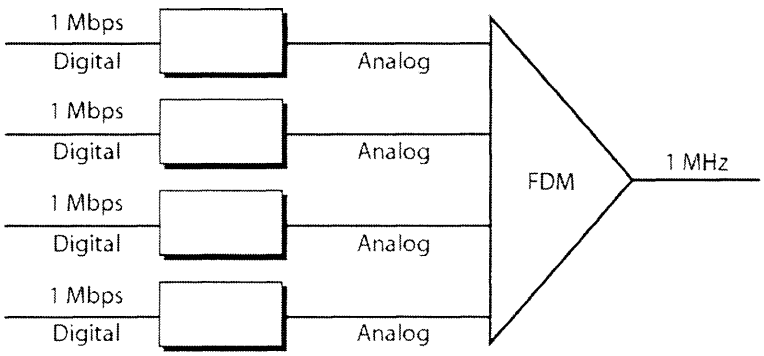
16. Four data channels (digital), each transmitting at 1 Mbps, use a satellite channel of 1 MHz. Design an appropriate configuration, using FDM (10 marks).



Answer

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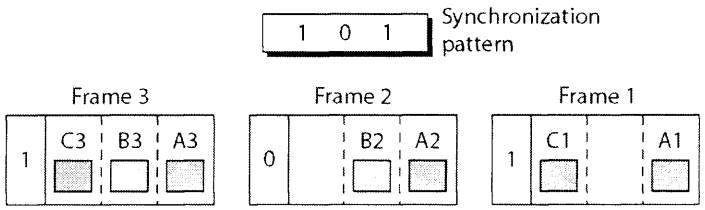
17. The figure shows synchronous TDM, We have four sources, each creating 250 8-bit characters per second. If the interleaved unit is a character and 1 synchronizing bit is added to each frame. Please find (15 marks)



(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.

Answer

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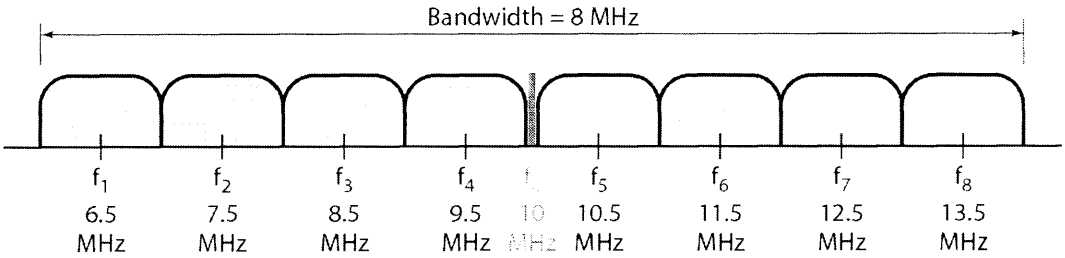
Part II

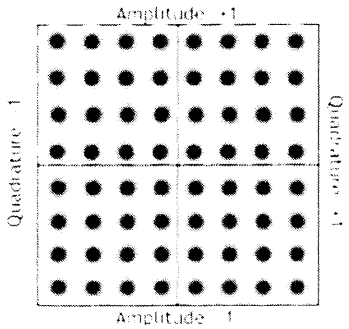
เลือกคำตอบที่ถูกที่สุดเพียงข้อเดียว (เลือกมากกว่า 1 ข้อ คะแนน -1 หากคำตอบถูกได้ 2 คะแนน หากตอบผิดได้ -1 คะแนน

1. We have an available bandwidth of 100 kHz which spans from 200 to 300 kHz. We need to send data 3 bits at a time at a bit rate of 3 Mbps. The carrier frequency is 10 MHz. We can have $L = 2^3 = 8$. The baud rate is S = 3 Mbps/3 = 1 Mbaud. This means that the carrier frequencies must be 1 MHz apart ($2\Delta f$ = 1 MHz). Figure below shows how we allocate the frequency spectrum for this scenario. However, in this question, we will re-use this frequency bandwidth by not using 3 bits per baud, but we will use one bit per baud. We still use FSK technique for this purpose. Assume that one baud uses only one clock cycle (10 marks).
   What the bandwidth (Mbps) can be achieved?



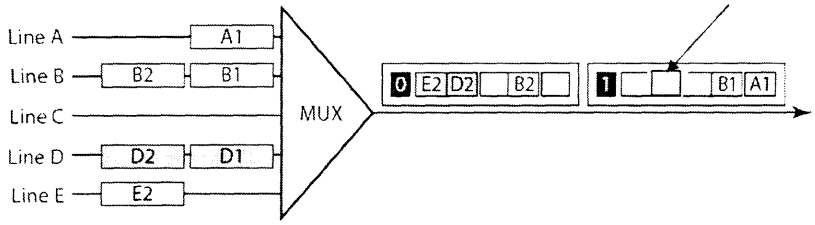
   a) 2 Mbps
   b) 4 Mbps
   c) 6 Mbps
   d) 8 Mbps
   e) No correct answer

2. What kind of modulation is used in the figure below?



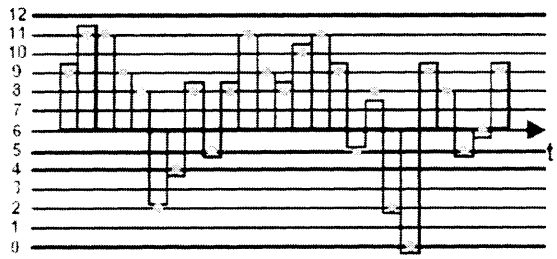
   a) 4*4 PAM
   b) 64 PSK
   c) 64 QAM
   d) 64 FSK
   e) 64 ASM

3. What is the data pointed by the arrow?



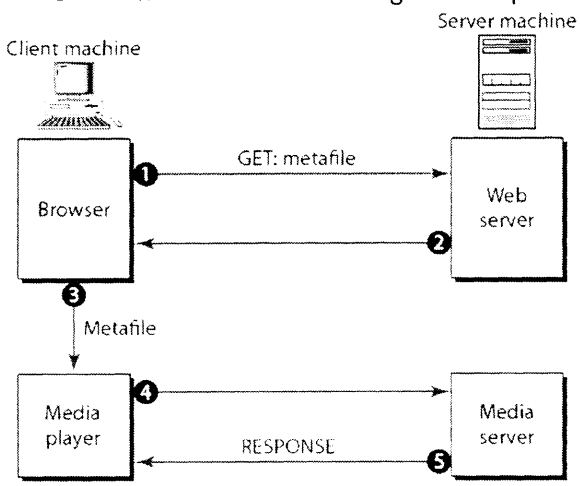
a) A1
b) B1
c) C
d) D1
e) E2

4. What is this step called in voice processing?



a) Digitization
b) Quantization
c) Sample and Hold
d) Analog to digital conversion
e) Digital to Analog conversion

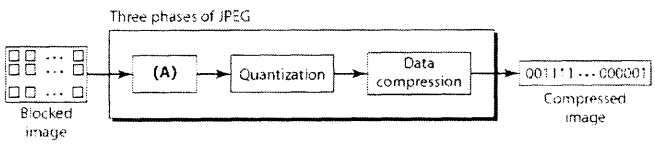
5. What is the command signal in step 2?



a) Setup
b) Response
c) Play
d) Pause
e) Get: audio/video file

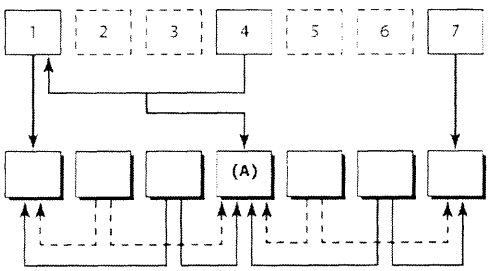
6. What is the command signal in step 4
   a) Setup
   b) Response
   c) Play
   d) Pause
   e) Get: audio/video file
7. Which one is true for G.711 audio codec?
   a) Bit rate is 64 kbps
   b) There are 2 sub-version: u-Law and A-law
   c) Sampling rate is 8 kbps
   d) Sampling size is 8 bits
   e) All of above
8. Which one is the advantage of G.723 over G.711
   a) Lower bit rate
   b) Sample size is bigger
   c) More delay in packetizing
   d) Need low bandwidth
   e) All of above

9. Below is a video process. What is (A)?



   a) Discrete Cosine Transform (DCT)
   b) Pulse code modulation (PCM)
   c) Video codec
   d) Analoug to digital conversion
   e) No correct answer

10. Below is MPEG process. What is (A)?



   a) I-frame

b) B-frame

c) P-frame

11. Which one is NOT a SIP message?

a) Invite

b) Response

c) Bye

d) Option

e) Register

12. We have an available bandwidth of 100 kHz which spans from 200 to 300 kHz. What is the bit rate if we modulated our data by using ASK with d = 1, r=1?

a) 10 kbps

b) 25 kbps

c) 50 kbps

d) 100 kbps

e) 500 kbps

13. An analogue signal carries 4 bits per signal element. If 1000 signal elements are sent per second, find the bit rate. If each signal element carries one bit information.

a) 1000 kbps

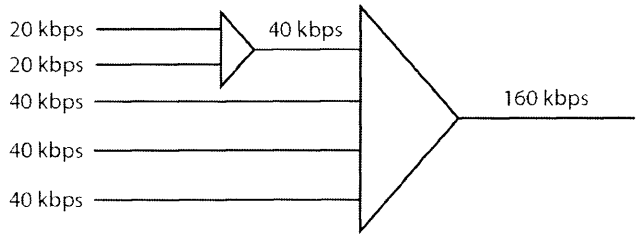
b) 2000 kbps

c) 4000 kbps

d) 5000 kbps

e) No correct answer

14. What do we call the multiplexing scheme given below?



a) Multilevel

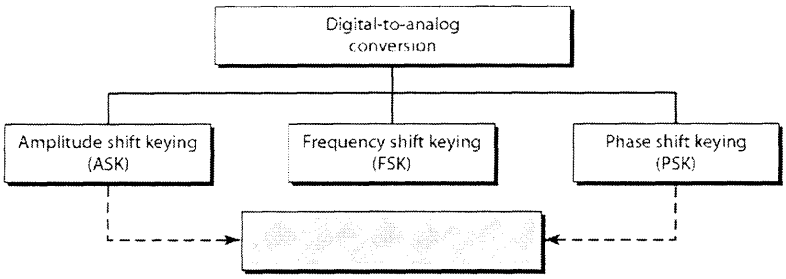
b) Multislot

c) Pulse stuffing

d) Bit interleaving

e) Byte interleaving

15. What is a missing box?



a) PAM

b) QAM

c) WDM

d) DWDM

e) No correct answer

Part III

ให้ตอบ T หากข้อความถูกต้อง ตอบ F หากข้อความไม่ถูกต้อง ตอบถูกได้ 1 คะแนนตอบผิดได้ -1 คะแนน

1. [ ] We can send analogue and digital signals directly over a medium.
2. [ ] The process of taking a group of bits from each input line for multiplexing is called interleaving.
3. [ ] To ensure that the receiver correctly reads the incoming bits, i.e., knows the incoming bit boundaries to interpret a "1" and a "0", a known bit pattern is used between the frames. These bits (or bit patterns) are called signal element bit(s).
4. [ ] The bandwidth usage by FM is higher than for AM
5. [ ] Streaming stored audio/video refers to the broadcasting of radio and TV programs through the Internet.
6. [ ] Spatial samples is the digital value of sampling points in a video frame.
7. [ ] The picture quality of video is depended on the temporal sampling rate or frame rate.
8. [ ] P-frame contains only the changes from the preceding frame.
9. [ ] Spread spectrum is a communication technique that spreads a narrowband communication signal over a wide range of frequencies for transmission
10. [ ] Frequency Hopping Spread Spectrum (FHSS) gives a better performance than DSSS (Direct Sequence Spread Spectrum)