$\qquad$

# PRINCE OF SONGKLA UNIVERSITY 

## FACULTY OF ENGINEERING

Final Examination: Semester II
Date: 27 February 2012

Academic Year: 2011
Time: 09.00-12.00

Subject: 241-360 Introduction to Communication Systems and Networks Room: R200

ทุจริตในการสอบ โทษขั้นต่ำคือ ปรับตกในรายวิชาที่ทุจริต และพักการเรียน 1 ภาคการศึกษา

## Part I

1. Select the best answer of each question: 2 marks for the correct one, -1 (minus one) for the wrong answer. No mark penalty if you leave the blank answers. ( 30 marks)

|  | A | b | c | d | e |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 1.1 |  |  |  |  |  |
| 1.2 |  |  |  |  |  |
| 1.3 |  |  |  |  |  |
| 1.4 |  |  |  |  |  |
| 1.5 |  |  |  |  |  |
| 1.6 |  |  |  |  |  |
| 1.7 |  |  |  |  |  |
| 1.8 |  |  |  |  |  |
| 1.9 |  |  |  |  |  |
| 1.10 |  |  |  |  |  |
| 1.11 |  |  |  |  |  |
| 1.12 |  |  |  |  |  |
| 1.13 |  |  |  |  |  |
| 1.14 |  |  |  |  |  |
| 1.15 |  |  |  |  |  |

$\qquad$
1.1 Which answer is correct for optical cable description?

a) $\mathrm{A}=$ Core, $\mathrm{B}=$ Light, $\mathrm{C}=$ Jacket, $\mathrm{E}=$ Cladding
b) $\mathrm{A}=$ Light, $\mathrm{B}=$ Cladding, $\mathrm{C}=$ Jacket, $\mathrm{E}=$ Core
c) $\mathrm{A}=$ Light, $\mathrm{B}=$ Cladding, $\mathrm{C}=$ Core, $\mathrm{E}=$ Jacket
d) $\mathrm{A}=$ Light, $\mathrm{B}=$ Core, $\mathrm{C}=$ Cladding, $\mathrm{E}=$ Jacket
e) No correct answer
1.2 which one is giving the bandwidth from low to high?
a) UTP $>$ Coaxial $>$ Fiber Optic
b) Coaxial $>$ UTP $>$ Fiber Optic
c) Fiber Optic $>$ Coaxial $>$ UTP
d) Fiber Optic $>$ UTP $>$ Coaxial
e) No correct answer
1.3 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.

$\qquad$
รหัส
$\qquad$

1.4 What is the cause of this figure?
a) synchronization
b) multiplexing
c) attenuation
d) data loss
e) no correction answer
1.5 Consider asynchronous transmission in the form of 7-bit characters with one start bit and 1.5 stop bits. For a 10 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?


Figure 1 Frame Format of a asynchronous serial communication
a) 100 usec
b) 50 usec
c) 6.67 usec
d) 6.33 usec
e) No correct answer
1.6 What is it called? (2 marks)


รหัส.
a) Wavelength dependence
b) Dense WDM
c) Multimode Graded - Index
d) Multimode Step - Index
e) No correct answer
1.7 Which one is true for fiber optic? (2 marks)
a) Very low attenuation
b) Noise immunity
c) Extremely high bandwidth
d) No corrosion
e) All are correct.
1.8 Which point is the best for fiber optic to use? (2 marks)

1.9 What is the sequence of the below problems in fiber optic? (3 marks)


```
ชื่อ.
a) End Gap, Concentricity, Eng Angle, NA Mismatch
b) End Gap, , Eng Angle Concentricity, NA Mismatch
c) Concentricity, End Gap, Eng Angle, NA Mismatch
d) End Gap, Concentricity, NA Mismatch, Eng Angle
e) Eng Angle, End Gap, Concentricity, NA Mismatch
1.10 Which one is true? (3 marks)

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.
1.11 What is the effect called? ( 2 marks)

a) Our of phase
b) Phase shift
c) Attenuation
d) Distortion
e) No correct answer.
1.12 Which one does describe 'baseband'? (3 marks)
a) Divides the total bandwidth into many channels
b) Each channel can carry a different signal
```

ชื่อ

``` \(\qquad\)
\(\qquad\)
c) carry many simultaneous transmissions
d) voice and data share the same cable
e) No correct answer
1.13 Which one does describe 'Full Duplex'? (3 marks)
a) allow data to be sent in both directions simultaneously.
b) A channel can be formed from two simplex channels carrying data in opposite directions. There is no waiting for turns or for the devices swap roles
c) Both end can communicate simultaneously
d) All are correct.
e) No correct answer.
1.14 Which one can give the highest bandwidth? (2 marks)
a) Twisted pair (UTP)
b) Shielded twisted pair (STP)
c) Fiber optic
d) Infrared
e) Microwave
1.15 Which one is the best to describe the below picture? ( 3 marks)

a) Erbium Doped Fiber Amplifiers
b) DWDM system
c) Impairments in optical amplification
d) Injection Laser diode (ILD)
e) Dispersion in optical amplification
\(\qquad\)

\section*{Part II}

\section*{ARQ Protocols}
2. Answer the following questions for Go-Back-N ARQ


Figure 2 Go-Back-N ARQ
2.1 Why does the receiver not answer ACK (step no. 2) of Frame 0? ( 5 marks)
2.2 What happen if the receiver does not give ACK2 (step no. 3)? (5 marks)
2.3 What happen if the receiver does not send ACK 3 (step no. 7)? (5 marks)
2.4 In Go-Back-N ARQ, a window side must be lest a number of data unit in one block. Why? (5 marks)
3. In a Stop-and-Wait ARQ system, the bandwidth of the line is 10 Mbps , and 1 bit takes 10 ms to make a round trip. What is the bandwidth-delay product? If the system data frames are 1000 bits in length, how long does it take to transmit 10 Mbytes data? Assume that all data are received correctly, e.g. no error and dropped. (10 Marks)


Figure 3 Stop-and-Wait ARQ operation
4. Below is the Selective Repeat ARQ operation. Answer the following questions: (10 Marks)


Figure 4 Selective Repeat ARQ operation
a. What will happen in step no. 6 and 7? ( 5 marks)
b. If ACK of step no 4 is received by the sender, what will happen in step no. 5? (5 marks)

\section*{Answer}
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
5. The figure below shows a sequence diagram of selective repeat ARQ protocol. The communication has some errors. Regarding to the mechanism of selective repeat ARQ


Figure 5 Selective repeat ARQ protocol

\section*{Answer}

รหัส

Figure 6 Stop-

and

> Wait ARQ mechmism

Stop-and-wait ARQ transmission efficiency is described by:
\[
\eta_{0}=\frac{R_{e f f}}{R}=\frac{\frac{n_{f}-n_{o}}{t_{0}}}{R}=\frac{1-\frac{n_{o}}{n_{f}}}{1+\frac{n_{a}}{n_{f}}+\frac{2\left(t_{\text {prop }}+t_{\text {proc }}\right) R}{n_{f}}} .
\]

Assume that in our transmission system, the frame size is 1,250 bytes (including 250 bytes overhead), ACK frame size is 25 bytes. The channel bandwidth is 1 Mbps . What are the efficiency of the system when the round trip time are: (a) 1 ms , (b) 10 ms , and (c) 100 ms .
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)

\section*{Error Detection and Correction}
7. Hamming Code can be applied for FEC (forward Error Correction) technique, as shown below

\(p_{2}\) will take care of these bits

7.1 If the original data is 10011110011 , what is the \((15,4)\) block error-correcting codes after using Hamming Code?
7.2 If the following data is received by the receiver, 100101110011101 , is the data corrupted? If yes, what is bit number is error?

Answer

รทัส
8. The below picture shows one cyclic redundancy check using a shift register circuit. Please fill in the given table before of each register value for each clock cycle. Also, please give the value os \(\mathrm{g}(\mathrm{x})\) and CRC.

\begin{tabular}{|c|c|c|c|c|}
\hline Clock & Input & \(\operatorname{Reg} 0\) & \(\operatorname{Reg} 1\) & \(\operatorname{Reg} 2\) \\
\hline 0 & - & 0 & 0 & 0 \\
\hline 1 & & & & \\
\hline 2 & & & & \\
\hline 3 & & & & \\
\hline 4 & & & & \\
\hline 5 & & & & \\
\hline 6 & & & & \\
\hline 7 & & & & \\
\hline & & & & \\
\hline
\end{tabular}
\(\mathrm{g}(\mathrm{x})=\) \(\qquad\)
CRC \(=\)

Answer
\begin{tabular}{|c|c|c|c|c|}
\hline Clock & Input & Reg 0 & Reg 1 & Reg 2 \\
\hline 0 & & & & \\
\hline 1 & & & & \\
\hline 2 & & & & \\
\hline 3 & & & & \\
\hline 4 & & & & \\
\hline 5 & & & & \\
\hline 6 & & & & \\
\hline 7 & & & & \\
\hline & & & & \\
\hline
\end{tabular}
\(\mathrm{g}(\mathrm{x})=\)
\(\mathrm{CRC}=\)
9. Officer A sends his information to officer B using Linear Block Code. The information is 4 bits consisting of (1101). Hence he is using (7,4) Linear Block Code and \(g(x)=x \wedge 3+x+1\). Please answer
a) What is the code word information (c)?
b) Show that by the time when officer B receives 1111000 , how he knows the information is an error.

\section*{Answer}
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
10.(a) What is statistical multiplexing? ( 5 marks)
(b) Why is it different from conventional multiplexing? ( 5 marks)
(c) What are the advantages of the statistical MUX compared to the convention MUX? (5 marks)

\section*{Answer}
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
11.(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)?
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
12. 24 channels are multiplexed using TDM. If each channel sends \(8,000 \mathrm{bytes} / \mathrm{s}\). we multiplex 1 byte per channel and 1 Synchronizing bit is add to each frame. Find (1) the duration of 1 bit before multiplexing, (2) the frame rate, (3) the duration of each frame, (4) the number of bits in each frame, and (5) the data rate of the link.


\footnotetext{
Answer
}


Answer
13.Two offices are communicating using TDM; four \(2-\mathrm{Kbps}\) 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```

