Tanta University

Department: Electronics and Communication Engineering
Total Marks: (90) Marks

Faculty of Engineering

| | | |
|---|---|---|
| **Course:** Mobile Communication Systems | **Course Code:** EEC 4230 | **Year:** 2nd Semester 2017-2018 |
| **Date:** 30/5/2018 (**Final Exam**) | **Time:** 3 hours | **No of Pages:** (4) pages |

**Remarks:**
- Answer (**only**) **Three** of the following Questions.
- It is **allowed** to use Erlang B, Erlang C, and Q-function Tables.

# Question # 1: (30) Marks

(a) (**5 Marks**) List the first generation and second generation cellular systems developed in Europe, North America, and Japan, and the multiple access and modulation schemes employed in each.
(b) (**5 Marks**) Briefly illustrate the principle that allows high capacity to be achieved in the cellular system compared to the early mobile radio systems.
(c) (**5 Marks**) A cellular service provider needs to upgrade the capacity of an existing cellular systems without compromising trunking efficiencies, nor increasing co-channel interference (CCI). Recommend one of the capacity expansion methods that meet this requirement.
(d) (**5 Marks**) A cellular service provider employing the second generation GSM technology is allocated 100MHz of frequency spectrum for its operations. Calculate the number of channels available and the number of users that can be serviced per cell, using each of the following multiple access / duplexing schemes: (i) FDMA/FDD, (ii) FDMA/TDD. [Assume that cluster size $N = 1$].

(e) (**10 Marks**) Suppose a MS is moving along a straight line between $BS_1$ and $BS_2$ as shown in Fig. 1. Assume the received power in dBm at $BS_i$ from the MS is given by: $P_{r,i} = P_0 - 10n\log_{10}(\frac{d_i}{d_0})$ for $i = 1, 2$. where $P_0 = 0$ dBm is the received power at distance $d_0 = 1$ m from the mobile antenna (Assume $n = 3$). If the minimum usable signal level for acceptable voice quality is $P_{r,min} = -90$ dBm and the threshold level used by the switch for handoff initiation is $P_{r,HO}$. Consider that MS is currently connected to $BS_1$ and is moving toward a handoff. The time required to complete a handoff, once that received signal level reaches the handoff threshold is $\Delta t = 4$ seconds. (i) determine the minimum margin $\Delta$ to assure that calls are not lost due to weak signal condition during handoff. (ii) describe the effects of the margin $\Delta = P_{r,HO} - P_{r,min}$ on the performance of cellular systems.

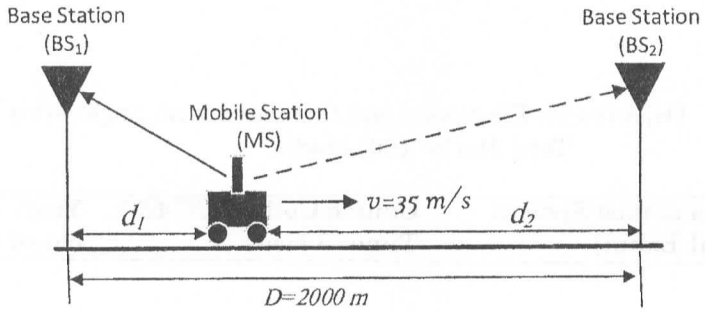


Figure 1

## Question # 2: (30) Marks

(a) **(8 Marks)** Using the SUI model, and the 4G WiMAX base station (BS) and mobile station (MS) parameters given below, predict the maximum realistic coverage distance $d$ from the BS that the average received power is greater than or equal to the minimum usable power defined for the WiMAX system, when the transmitter and the receiver have line of sight (LOS) path between them (use terrain type C with $a = 3.6, b = 0.005, c = 20$). **Hint:** SUI Model is given in page 4.

| | |
|---|---|
| WiMAX Parameters: | $P_{t,BS} = 43$ dBm, $G_{t,BS} = 18$ dB, $G_{r,MS} = 6$ dB, $f_c = 3$ GHz, $d_0 = 100$ m, $S = 10$ dB, $h_{t,BS} = 25$ m, $h_{r,MS} = 1.5$ m, $\sigma = 10$, Receiver Sensitivity = -95 dBm |

(b) **(8 Marks)** If $P_t = 10$ W, $G_t = 10$ dB, $G_r = 3$ dB and $L = 1$ dB at 900 MHz, compute the received power for the knife-edge geometry shown in Fig. 2. Compare this value with the theoretical free space received power if an obstruction did not exist. What is the path loss due to diffraction for this case?

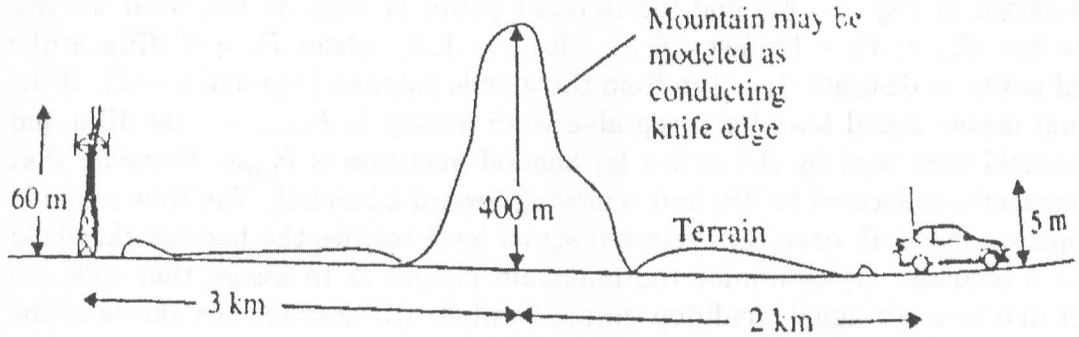


Figure 2

(c) **(7 Marks)** Assume a SNR of 25 dB is desired at the receiver. If a 900 MHz cellular transmitter has an EIRP of 100 W, and the AMPS receiver uses a 0 dB gain

# Question # 4: (30) Marks

(a) (**10 Marks**) Assume a mobile channel with channel bandwidth of 30 kHz and three possible values of received SNR per bit: $\gamma_1 = 0.8333$ with probability $p(\gamma_1) = 0.2$, $\gamma_2 = 83.33$ with probability $p(\gamma_2) = 0.5$, and $\gamma_3 = 333.33$ with probabilities $p(\gamma_3) = 0.3$. Find the average data rate correctly received (throughput) for outage probabilities $P_{out} = 0.2$ and $P_{out} = 0.7$.

(b) (**6 Marks**) Given that a single branch Rayleigh fading signal has 10 % chance of being 3dB below some SNR threshold. Calculate the probability that 6-branch SC diversity receiver operating in this channel will have its SNR 6dB below the threshold.

(c) (**10 Marks**) QPSK and GMSK signals have the following Bit error probability over AWGN channels:

$$P_e = Q(\sqrt{\frac{2Eb}{N_0}}) \qquad (QPSK)$$

$$P_e = Q(\sqrt{\frac{2 \times 0.68 \times Eb}{N_0}}) \qquad (0.25GMSK)$$

where $Q(x) \approx \frac{1}{12}e^{-\frac{1}{2}x^2} + \frac{1}{4}e^{-\frac{4}{6}x^2}$

(i) Derive an expression for the bit error probability fo QPSK and 0.25GMSK over Rayleigh fading channel.

(ii) Using your expression over Rayleigh fading channel, compare the performance of two mobile devices at 0 dB SNR, if one of them employs QPSK modulation while the other employs 0.25GMSK.

(d) (**4 Marks**) The Shannon capacity of AWGN channel is given by: $C = B\log_2(1+\gamma)$, where $\gamma$ denotes the SNR, and $B$ is the channel bandwidth. Write expressions for the capacity of the following wireless communication systems:

(i) Rayleigh fading channel with two transit and one receiving antenna,

(ii) Rayleigh fading channel with two transmit and three receiving antennas.

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***Formulas and Tables:***

***SUI Model:***

$PL_{SUI}[dB] = A + 10n\log_{10}(\frac{d}{d_0}) + X_f + X_h + S$

$A = 20\log_{10}\frac{4\pi d_0}{\lambda}$

$n = a - bh_{tx} + \frac{c}{h_{tx}}$

$X_f = 6\log_{10}\frac{f}{2000}$

$X_h = \begin{cases} -10.8\log_{10}\frac{h_r}{2} & \text{for terrain A, B} \\ -20\log_{10}\frac{h_r}{2} & \text{for terrain C} \end{cases}$

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**Good Luck**

**Dr. Hussein E. Seleem (Course Coordinator)**

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antenna and has a 10 dB noise figure, find the percentage of time that the desired SNR is achieved at a distance of 10 km from the transmitter. Assume $n = 4, \sigma = 8$ dB and $d_0 = 1$ km.

(d) (**7 Marks**) Given an indoor path loss model of the form:

$$\bar{PL}(d)[dB] = 40 + 20\log_{10} d + \sum FAF \qquad d \geq 1 \text{ m}$$

where $d$ is measured in meters, find the mean received power between three floors of a building if $FAF$ is 15 dB per floor. Assume the transmitter radiates 20 dBm and unity gain antennas are used at both the transmitter and receiver, and that the straight-line path between the transmitter and receiver is 15 m through the floors.

# Question # 3: (30) Marks

(a) (**8 Marks**) Compute the RMS delay spread and the 90% coherence bandwidth for a multipath channel with power delay profile shown in Fig. 2.

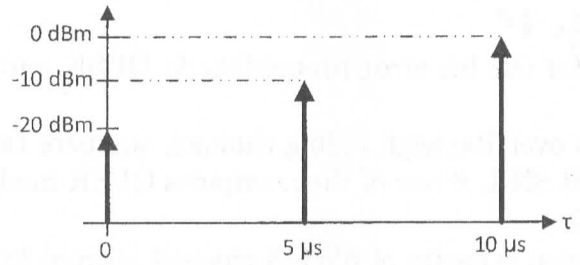


Figure 3

(b) (**4 Marks**) Given that USDC (IS-54) cellular system operates over the channel in part (a), determine the maximum bit rate that can be transmitted without requiring an equalizer at the receiver.

(c) (**6 Marks**) What are the benefits of the following digital modulation schemes over their legacy systems: (i) $\pi/4$QPSK (legacy: QPSK), (ii) GMSK (legacy: MSK; FSK), and mention one example of cellular system employing each of them.

(d) (**8 Marks**) A cellular service operator has a total of 8 MHz frequency spectrum available for its services in an urban area of 296 square miles. if frequency re-use factor of 0.25 is used, find the total number of users that can be supported for a trunked system with 0.3 % probability of blocking specified (Erlang B), and traffic per user $A_u = 0.1$ Erlangs. (given hexagonal cells of area = 37 square miles), assuming GSM technologies is deployed.

(e) (**4 Marks**) Explain the effects of the following on data rate:
(i) Receiver diversity (ii) MIMO multiplexing.

Tanta University | Department: Electronics and Electrical Communication Eng. | Faculty of Engineering

Total Marks: 85 Marks

| | | |
|---|---|---|
| **Course Title: Information Theory** | **Course Code: EEC4237** | **Year: 4th** |
| **Date: 2 /6 /2018** | **Allowed time: 3h** | **No of Pages (2)** |

**Remarks: (answer the following questions, assume any missing data, answers should be supported by sketches, Neat answers and boxed results are appreciated)**

## *Question (1)* *[20 degree]*

a) Complete the following sentences

1. ..... is the ultimate data compression; while ..... is the ultimate transmission rate of communication.
2. Conditions for deterministic channel are ....., .....
3. Mutual information is symmetrical means .....
4. Let X and Y be independent discrete random variables, then $H(X/Y)$= ....., $H(X,Y)$=....., and $I(X;Y)$= .....
5. $I(X;X)$= .....
6. A vector is a codeword if and only if .....

b) If $I(X;Y_1)=0$ and $I(X;Y_2)=0$, does it follow that $I(Y_1;Y_2)=0$? In other words, if $Y_1$ is independent of $X$, and if $Y_2$ is independent of $X$, is it true that $Y_1$ and $Y_2$ are independent? Comment.

c) Figure 1 shows a discrete information source $S=\{s_1, s_2 \text{ and } s_3\}$. The symbols have the probability of occurrence, $P(s_1)=0.2$, $P(s_2)=0.1$, and $P(s_3)=0.7$. It is assumed that sequenced symbols of the information source are statistically dependent. The following transition probabilities are known: $P(s_2/s_3)=P(s_1/s_1)=P(s_2/s_2)=0$, and $P(s_1/s_2)=0.8$. Determine all transition probabilities. Calculate the entropy of the second extension of $S$.

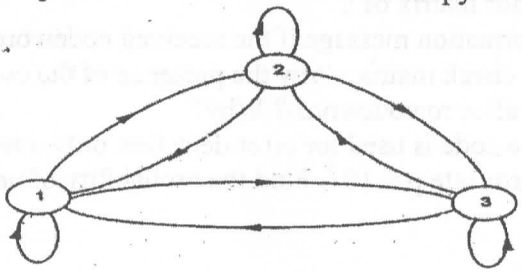


*Figure 1*

## *Question (2)* *[25 degree]*

a) For channel in Figure 2, define channel type. Find $H(X/Y)$, and $H(X)$. Comment on results.

b) For channel in Figure 3, define channel type. Calculate the channel capacity.

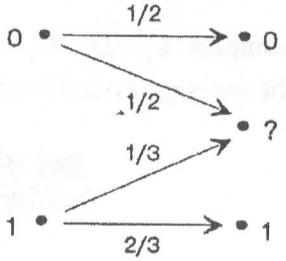


*Figure 2*

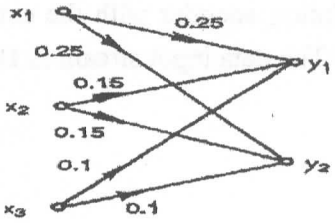


*Figure 3*

c) For a binary symmetric channel whose input source is the alphabet X = {0, 1} with probabilities {0.5, 0.5} and whose output alphabet is Y = {0, 1}, having the following channel matrix where $e$ is the probability of transmission error:

$$\begin{pmatrix} 1-e & e \\ e & 1-e \end{pmatrix}$$

1. How much uncertainty is there about the input symbol once an output symbol has been received?
2. What is the mutual information I(X; Y) of this channel?
3. What value of $e$ maximizes the uncertainty H(X|Y) about the input symbol given an output symbol?
4. How many values are there for $e$ for which the mutual information of this channel is maximal? What then is the capacity of such channel?
5. For what value of $e$ is the capacity of this channel minimal? What is the channel capacity in that case?

***Question (3)*** ***[20 degree]***

(a) Check if the following code $C = \{0, 11, 100, 110\}$ is instantaneous or not? If not; find its instantaneous one.

(b) For a (7,4) linear block code, the generator polynomial $g(x)$ is given by $1+x^3$. Find the generator matrix and the parity check matrix for this code.

(c) A linear block code C is defined by the following parity check matrix,

$$\begin{bmatrix} 1\,0\,0\,0\,1\,1 \\ 0\,1\,0\,1\,0\,1 \\ 0\,0\,1\,1\,1\,0 \end{bmatrix}$$

1. What is the code rate?
2. Find the generator matrix of C.
3. What is the information message if the received codeword is "010011"?
4. Does the parity check matrix allow the presence of the codewords of weight < 3 (apart from the all zero codeword)? Why?
5. Suppose that the code is used for error detection only over a binary symmetric channel with error rate p = $10^{-3}$. Find the probability of undetected error.

***Question (4)*** ***[20 degree]***

a) Check whether the received signal "0010111010101100" is error-free or not using Hamming code (16, 11), where the Hamming bits are in positions 1, 2, 4, 8, and 16.

b) Show how CRC is using to detect and correct any error in the received message at a channel output when the data message was "1011011010", using the polynomial $P(x)=x^4+x^3+1$.

c) Construct a convolution encoder with the commutator samples $C_1=D_1$, $C_2=D_1 \oplus D_2$, and $C_3=D_1 \oplus D_2 \oplus D_3$. The data input stream is 1011. Find the message coded by the encoder.

*Best Wishes of Success*
*Dr. Heba A. El-Khobby*

Faculty of Engineering
Tanta University
Electronics and Electrical Comm. Dept.

كلية الهندسة
جامعة طنطا
قسم هندسة الإلكترونيات والإتصالات الكهربية

**4th year 6-6-2018** | **Final Exam** | **Second Term 2017-2018**

**[75 Marks]** | **Microwave Engineering** | **Code (EEC 4232)**

**Time (3 hours), (Exam in two papers)**

***Answer the following five questions:***

***Question (1)*** **[15 Marks]**

(a) Why the performance of the conventional tubes is impaired at microwave frequencies.
(b) Explain the transit angle effect on the triode amplifier.
(c) Explain why the beam loading admittance is equal for both buncher and catcher in DCK.
(d) Explain why the reflex klystron does not oscillate at the first mode.
(e) Explain why the gain of the TWT is very high.

***Question (2)*** **[15 Marks]**

(a) **Derive** an expression for the optimum distance between the buncher and catcher at which maximum bunching occur in DCK.
(b) A DCK amplifier has a voltage gain = 15 dB, input power =5mWatt, total shunt impedance of the cavity at the input = 30 $k\Omega$ , total shunt impedance of the output cavity = 40 $k\Omega$, load impedance at the output cavity = 48 $k\Omega$
1. What is the input voltage signal (rms).
2. What is the output voltage signal (rms).
3. What is the power delivered to the load in watts and in $dB_m$.
4. DCK gain neglecting beam loading on the output cavity.

***Question (3)*** **[15 Marks]**

(a) **Derive** an expression for the output power of the RK.
(b) **Explain with drawing** how the RK operation reaches the steady state.
(c) The parameters of a reflex klystron are: $I_0 = 100mA$, $V_0 = 3000V$, the distance between the grids of the cavity is 1mm, and the operating frequency is $f = 1GHz$. For optimum operating conditions at the second mode calculate:
1. Dc transit time of electrons.
2. The electronic admittance if the output voltage is 70 volt.
3. If $G_C = G_L = (0.6 * 10^{-4})\Omega^{-1}$ does the reflex klystron oscillate or not.

## *Question (4)* [15 Marks]

(a) **Derive** an expression for the TWT electronic gain.

(b) **Explain** why the TWT overall gain is lower than the TWT electronic gain

(c) A travelling wave tube operates under the following parameters: beam voltage $V_0 = 2500\ V$, beam current $I_0 = 50\ mA$, characteristic impedance of the helix $Z_0 = 6.75\ \Omega$, helix length $L = 10\ cm$, pitch length $P = 0.2cm$, and the applied signal frequency $f = 8\ GHz$. **calculate:**

1- The gain parameter C.
2- The output power gain.
3- The three forward propagation constants.

## *Question (5)* [15 Marks]

(a) **Draw** the I-V characteristic curve of the tunnel diode and **explain** with the aid of the energy band diagrams the following regions of operation:
$V = 0$, $0 < V < V_p$, $V_p < V < V_v$, and $V = V_v$.

(b) **Draw** the equivalent circuit of the tunnel diode and **derive** an expression for the resistive cutoff frequency and self-resonance frequency.

(c) A tunnel diode has the following parameters; $I_P = 10mA$, $I_V = 0.125mA$, $V_P = 0.237V$, $V_V = 0.4V$, $c_j = 20PF$, $R_s = 1\Omega$, and $L_s = 5nH$ **Find** the resistive cut off frequency and self-resonance frequency.

*With my best wishes*

*Dr/ Amr Hussein*

Tanta University

Department: Electronics and Electrical Communications Engineering

Faculty of Engineering

**Total Marks:** (85) Marks

**Final Exam**

Course Title: Multimedia and Image Processing (Elective course 4) Course Code: EEC4235 Year: 4rd
Date: 09/06/2018 Allowed time: 3 hrs. No. of Pages: 2

**Please answer All the following questions**

**Question No. 1** (20 Marks)

**A. Mention the main components and the required features of the multimedia system and its applications.**

**B. Draw with detailed explanation the block diagram of the general image compression model.**

**C. Address five lossless compression methods and five lossy compression methods that can be used in the multimedia applications.**

**D. Illustrate the block diagram of the lossy compression system with explanation.**

**Question No. 2** (25 Marks)

**A. I) Define the compression ratio.**

**II) Address the three types of the data redundancy with explanation. In addition, mention how to reduce the interpixel redundancy.**

**III) Write the expressions of the compression ratio and the relevant data redundancy, if $n_1$ and $n_2$ are the number of bits before and after compression; respectively. What are the values of $C_R$ and $R_D$ if $n_2 = n_1$ and if $n_2 \ll n_1$ ?**

**B. I) Define the entropy and its mathematical expression.**

**II) Find the first order and the second order estimates of the entropy of an image that has the following representation:**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 21 | 21 | 21 | 95 | 169 | 243 | 243 | 243 |
| 21 | 21 | 21 | 95 | 169 | 243 | 243 | 243 |
| 21 | 21 | 21 | 95 | 169 | 243 | 243 | 243 |
| 21 | 21 | 21 | 95 | 169 | 243 | 243 | 243 |

**C. I) What is the main goal of the feature extraction process?**

**II) What are the criteria and characteristics that should be satisfied in the extracted features?**

**III) Define the concept of the feature vector.**

**D. I) Mention seven common binary object features.**

**II) Mention five histogram features of an image including their definitions.**

**Question No. 3(20 Marks)**

**A. What are the purposes of using the adaptive median filter? Write down its algorithm.**

**B. Define the image restoration process, and then mention the main difference between the enhancement and the restoration processes?**

**C. I) In the digital images, what are the main sources of noise that arises during the image acquisition (digitization) and transmission?**

**II) Mention with drawing four noise models.**

**D. For image restoration, name all possible proper filters to remove the following noise types: Gaussian noise, Salt noise, Pepper noise, Random Gaussian noise, and Uniform noise.**

**Question No. 4 (20 Marks)**

**A. I) Define the clustering process.**

**I) Mention the main two types of the clustering techniques.**

**II) What is the difference between the clustering and the classification processes?**

**B. I) Explain in details the concept of the k-means algorithm.**

**II) Write the k-means steps for image segmentation.**

**C. Apply the k-means using K=2 on the following data:**

| Individual | Variable 1 | Variable 2 |
|---|---|---|
| 1 | 1.0 | 1.0 |
| 2 | 1.5 | 2.0 |
| 3 | 3.0 | 4.0 |
| 4 | 5.0 | 7.0 |
| 5 | 3.5 | 5.0 |
| 6 | 4.5 | 5.0 |
| 7 | 3.5 | 4.5 |

**D. Address the drawbacks of the k-means clustering technique.**

*End of Questions*

*Good luck*

**Dr. Amira S. Ashour**

٤ إتصالات - ٢٠١٨/٥/٢٦

Tanta University | Department: Electronics & Electrical Communications | Faculty of Engineering

Total Marks: (75) Marks

Course Title: Computer Communication Networks | Course Code: 4231 | Year: 2017/2018
Date: 26/5/2018 | Allowed time: (3) hrs. | No. of Pages: (4)

**Question No. 1 :**

**Choose the correct answer to complete the sentence:** **(10 Marks)**

1. **Partitioning schemes (TDMA, FDMA) are better than random access schemes (Aloha, CSMA) when .....**
   a. accommodate large number of bursty users.
   b. less nodes have packets to send.
   c. all nodes have packets to send.
   d. on-demand transmission of bursty or steady streams is required.

2. **CDMA works with.....**
   a. both wired and wireless networks.
   b. only wireless networks.
   c. only wired networks.
   d. neither wired nor wireless networks.

3. **.....layer provides reliable delivery and flow control.**
   a. Network
   b. Transport
   c. Data link
   d. Both b & c

4. **.....layer is both software and hardware.**
   a. Network
   b. Session
   c. Transport
   d. Physical

5. **In the polling access method (centralized polling) the select function is used when.....**
   a. no data are being sent.
   b. the primary has frames to send.
   c. the secondary waits for ACK to send the data
   d. station captures a special frame called tree token.

6. **Random Access Protocols are.....protocols.**
   a. decentralized
   b. centralized
   c. unlimited throughput and heavier traffic
   d. high-delay



7. **Transmission data rate is decided by.....**
   a. network layer
   b. physical layer
   c. data link layer
   d. transport layer

8. **A ..... is used to direct user traffic.**
   a. routing table
   b. routed protocol
   c. routing protocol
   d. routing algorithm

9. **Cost based on cumulative bandwidth from source to destination in.....**
   a. RIP
   b. IGRP
   c. EIGRP
   d. OSPF

10. **The IV used to produce the RC4 stream in the Wired Equivalent Privacy (WEP) is ...**
    a. 24-bit
    b. 64-bit
    c. 128-bit
    d. 40-bit

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**Question No. 2:**

**Complete the following sentence:** **(10 Marks)**

A. .....is a collection of networks under a common administration sharing a common routing strategy.

B. In the .....process, host scans channels, listening for beacon frames.

C. The IEEE 802.x LAN standards deal with .....of the TCP/IP model.

D. The layer 1 devices like hubs are ....., they have no decision making abilities.

E. ..... can divide a large network into smaller segments.

F. .....is defined as a network segment that shares bandwidth with all other devices on the same network segment.

G. ..... can accept a packet formatted for one protocol (Appletalk) and convert it to a packet formatted for another protocol (TCP/IP) before forwarding it.

**H.** The last 24 bits of MAC address define.....

**I.** Examples of single segment networks: .....

**J.** The higher portion of the data link layer is often called .....and it is responsible for.....

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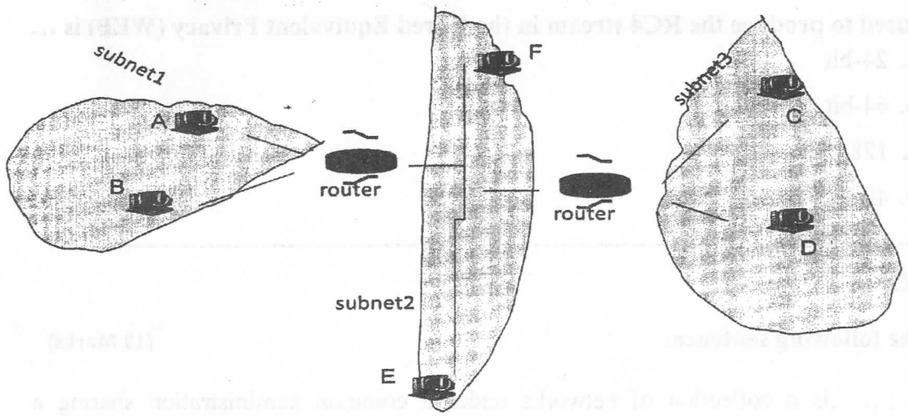
**Question No. 3:** **(25 Mark)**

**A.** Consider three LANs interconnected by two routers below. **(9 Marks)**

1. Redraw the diagram to include the adapters and assign MAC addresses to all the adapters.
2. Assign IP addresses to all of the interfaces. For subnet 1 use addresses of the form 111.111.111.xxx; for subnet 2 uses addresses of the form 122.222.222.xxx; and for subnet 3 use addresses of the form 133.133.133.xxx.
3. Consider sending an IP datagram from host A to host D. Suppose all of the ARP tables are up to date. Explain all the steps and describe the content of the routing table of each router.




**B.** Differentiate between: ARP table, MAC address table, and routing table. **(6 Marks)**

**C.** In Stop and wait protocol every 4th packet is lost and we need to send total 10 packets so how many transmissions it took to send all the packets? Repeat for Selective Repeat ARQ. **(5 Marks)**

**D.** Suppose you were to choose between three ARQ protocols: stop-and-wait, go-back-N and selective repeat ARQ. Which one would you choose if the packet loss rate is high and why? What could be one disadvantage of your choice of the ARQ protocol? **(3 Marks)**



**Question No. 4:** **(30 Mark: 6 marks for each item)**

**A.** 802.11 framing is complex compared to Ethernet framing. Explain with drawing the address fields of the frame in the following cases:

- ad hoc network.
- frame from distribution system.
- frames to the distribution system.

**B.** If you have four LANs. Show with drawing how to connect them with and without backbone. Which one is recommended and why?

**C.** Compare with drawing between different methods of authentication in wireless LAN.

**D.** With RTS/CTS on an 802.11 network:

1. Is it possible for two nodes to send RTS packets at the same time? Is it still possible for two RTS packets to collide? If so, how?
2. What prevents a node from sending a RTS packet while another node is sending a data packet? Is it still possible for an RTS packet to collide with a data packet? If so, how?
3. What prevents two nodes from sending data packets at the same time? Is it still possible for two data packets to collide? If so, how?

**E.** For a pure ALLOHA network transmit 200-bit frames on a shared channel of 200 kbps. What is the requirement to make this frame collision-free? Repeat for slotted ALLOHA.

*The end of questions*

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**Good luck**

**Dr. Rodyat Ismail (Coordinator of the Course)**