

**BACHELOR IN ENGINEERING YEAR 3**

**EEE748 – TELECOMMUNICATIONS SYSTEM.**

**FINAL EXAMINATION - SEMESTER I - 2014.**

**EXAM TIME: 3 HOURS**

**INSTRUCTIONS TO STUDENTS:**

1. You are allowed 10 minutes **EXTRA** as reading time during which you are **NOT** to write.
  2. Begin each answer on a fresh page and use both sides of the sheet.
  3. Write your candidate number at the top of each attached sheet.
  4. Insert all written foolscap, graph paper, drawing paper, etc. in their correct sequence and secure well.
  5. For all sheets of paper on which rough/draft work has been done, cross it through and attach to your answer scripts.
  6. Show all workings where necessary
  7. Diagrams and graphs can be drawn in pencil.
  8. Non- programmable calculators are allowed.
  9. Attempt all questions in Sections A & 4 out of 5 Questions in Section B
  10. Check your work before you leave the room!!
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## **SECTION A – SHORT ANSWERS**

**[20 Marks]**

**(2 mark each)**

1.	<i>What is the Frequency ranges of Extremely Low Frequency "ELF" and Extremely High Frequency "EHF Band" in the Radio frequency spectrum.</i>	
2.	<i>List two main sources of external noise in the receiver and give an example of each.</i>	
3.	<i>What happens when a mobile station (MS) is switched on and in "idle mode".</i>	
4.	<i>What is your understanding on the "sampling theorem" for PCM and determine the sampling rate for a signal of 4 – 10KHz.</i>	
5.	<i>An antenna is a passive device. Discuss why a directional antenna can be considered to have a "gain"?</i>	
6.	<i>Determine the modulating index (m) of an AM signal when <math>V_{carrier} = 5V(p - p)</math> and <math>V_{signal}</math> is <math>7(p - p)</math>? Discuss the shape of the modulated waveform?</i>	
7.	<i>Give two reasons why the IF stage of a receiver has more amplifications than the RF stage.</i>	
8.	<i>What is "quantization noise" or "quantization distortion" in PCM and how can they be reduced?</i>	
9.	<i>What are the two components of an electromagnetic wave and how are they created?</i>	
10.	<i>In your own words discuss the term "modulation" and the reason why modulation is required in Communication.</i>	

**SECTION B: ANSWER FOUR (4) OUT OF FIVE (5) QUESTIONS.  
(20 MARK EACH).**

Q1

- (a) An amplitude modulated wave consists of a Carrier frequency - a sine wave at one frequency; together with a modulating wave which in theory could be another sine wave (or cosine wave) but at a lower frequency superimposing upon the Carrier. Given the formulae of the Carrier signal ( $c(t)$ ) and the modulating signal ( $m(t)$ ), demonstrate mathematically and show in a diagram that the overall modulated signal consist of a Carrier and two sidebands.

Carrier signal:  $c(t) = C \sin(\omega_c t + \theta)$

Modulating signal:  $m(t) = M \cos(\omega_m t + \theta)$

(Assume C and M = 1 and  $\theta = 0$ )

(7 marks)

- (b) Explain the cause of over-modulation in AM, its effect and how it can be resolved.

(4 marks)

- (c) Provide the reasons why SSB is widely used to providing effective communication

(3 marks)

- (d) A Communication receiver consists of various components and circuits and one of its primary roles is to have good sensitivity and selectivity to fully reproduce the modulating signal at its output.

- i) Draw and label a block diagram of a typical Superheterodyne receiver; and  
ii) Discuss the reasons why it is used commercially as compared to the Tuned Radio Frequency (TRF) receiver

Block diagram & labeling (3 marks)

Discussion (3 marks)

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Q2

(a) A large geographical area has to be serviced by a single Base Station (BS) in mobile communications but limited frequencies are available for this type of service. Apply your knowledge on "*cellular structure of a mobile radio network*" to explain how mobile service providers overcome this problem.

(5 marks)

(b) With the aid of a diagram, explain the structure of a GSM network. What are the main network elements and what are their roles in the operation of GSM?

(5 marks)

c) What is "handover" or "hand-off" in mobile communication? Explain how handover is performed in the GSM network

(4 marks)

(d) Explain how "location" update is performed in GSM when an incoming call is made to a mobile station (MS)

(4 marks)

(e) What are the main advantages of cellular systems compared with the old generation radio telephone systems that did not utilize a cellular network structure?

(2 marks)

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Q3 Communication network and equipment standardization is very important in the telecommunication sector.

a) Provide and discuss two (2) main reasons why "Open Telecommunication Standardization" is important in the world telecommunication industry.

(3 marks)

b) Analyze two main reasons why some countries do not comply or want to be part of open standardization of equipment or system.

(3 marks)

c) Explain why manufacturers in small countries strongly support global standardization?

(2 marks)

d) ITU is one of the most recognized global organizations with about 200 members; explain the role of its two major standardization bodies? (4 marks)

e) Transmission systems may use copper cable, optical cable or radio channels to interconnect far-end and near-end equipment. Discuss the advantages of (i) optical transmission, (ii) microwave radio transmission, and (iii) satellite transmission? Compare their characteristics.

(8 marks)

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Q4 Multiplexing is a process that combines several signals for simultaneous transmission in one transmission channel.

- (a) Explain the difference between Frequency Division Multiplexing and Time Division Multiplexing? (5 marks)
- (b) The process of converting the amplitude of each pulse into a stream of 1s and 0s is called Pulse Code Modulation. Discuss the processes involved in PCM. (6 marks)
- (c) With the understanding that Voice frequency band is within the band 0.3 – 4.0KHz, demonstrate that the E1 Carrier system consists of 2048Kbps. (4 marks)
- (d) High order PCM multiplex is developed out of several primary multiplex sources. With the aid of diagrams, demonstrate how a PDH (European standard) 34Mbps transmission system is developed? (5 marks)

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Q5.

- (a) Signaling and switching are implemented to enable a connection from one subscriber to another in the telecommunication network.
  - (i) With aid of diagrams, analyze the difference between circuit-switched and packet-switched data networks as used in telecommunication networks. What are their advantages and disadvantages? (6 marks)
  - (ii) What would be the consequences if Service Providers enable prioritizing some packets over someone else's packets? (2 marks)
  - (iii) What is your understanding about Signaling System No.7 (SS7) (2 marks)
  - (iv) Explain the reason why clocking (synchronization) is important in a National Telecommunication System? (2 marks)
- (b) A Communication Transmitter is an electronic device that accepts the information signal to be transmitted and convert it into an RF signal capable of being transmitted over a long distance to a receiver.

(i) List down and discuss the four (4) basic function of a transmitter (2 marks)

(ii) An FM broadcast signal was deviated to 100 KHz from a 10 KHz modulating signal.

Determine the maximum bandwidth using:

- i) The Bessel Function (see attached)
- ii) Carson's rule.

(6 marks)

-----**The End**-----