BITS Pilani, Dubai Campus

Dubai International Academic City

B.E. (ECE), Third Year – Second Semester, 2011-2012

Comprehensive Examination

Course No. / Course Title: ECE C392 / Modern Communication Technologies

Duration: 3 hours Max. Marks: 80 Weightage: 40%

Note: *1. This question paper has two pages.*

2. Answer all questions. Appropriate assumptions may be made, where necessary.

1. **Distinguish between energy signals and power signals with examples. Show that for a real power signal, the autocorrelation function is the inverse Fourier transform of the power spectral density. (8 marks)**

2. **Find the signal-to-quantization noise power ratio (in dB) when the signal $s(t) = 3\cos 500\pi t$ is uniformly quantized using 10-bit PCM. (4 marks)**

3. **Design a matched filter detector for the two baseband signals $s_0(t) = \begin{cases} +1, & 0 < t \le 0.5 \\ -1, & 0.5 < t \le 1 \end{cases}$ and $s_1(t) = \sin 2\pi t, \ 0 < t \le 1$. The additive noise in the channel has a two-sided power spectral density of 0.1 watt/Hz. Find the bit error rate. (8 marks)**

4. **The noise figure of a cell phone receiver is specified as 16 dB. What is the equivalent noise temperature? (4 marks)**

5. **State the channel-coding theorem. What is its limitation? (4 marks)**

6. **Prove that a receiving station can get the data sent by a specific sender if it multiplies the entire data on the channel by the sender's chip code and then divides it by the number of stations. Assume that there are four stations sending the data d_1, d_2, d_3, d_4, respectively, with corresponding chip codes c_1, c_2, c_3, c_4. (6 marks)**

7. **In the design of a reliable communication system, we are confronted with two conflicting phenomena: a wireless channel that produces bursts of correlated bit errors and a convolutional decoder that cannot handle error bursts. Discuss a technique for resolving this conflict. (8 marks)**

8. Define cochannel reuse ratio as applied to cellular communications. Show that for hexagonal geometry, the cochannel reuse ratio is given by $\sqrt{3N}$, where *N* is the cluster size. (6 marks)

9. Explain the handoff strategies with practical considerations in a cellular system. (6 marks)

10. Discuss, with appropriate mathematical analysis, a two-ray model for multipath propagation assuming that the receiver is stationary. What happens to the amplitude if the position of the receiver is changed? (8 marks)

11. What is meant by coherence time of a channel? Distinguish between slow fading and fast fading in terms of coherence time. (6 marks)

12. Explain with the help of a flow diagram how CSMA / CA prevents collisions in wireless networks. (8 marks)

13. Name and compare the two common types of light emitters used in fiber optics. (4 marks)

========== Paper ends. Good luck! ==========

BITS Pilani, Dubai Campus

BE (Hons.) ECE Third Year, Second Semester, 2011-2012

Test 2 (Open Book)

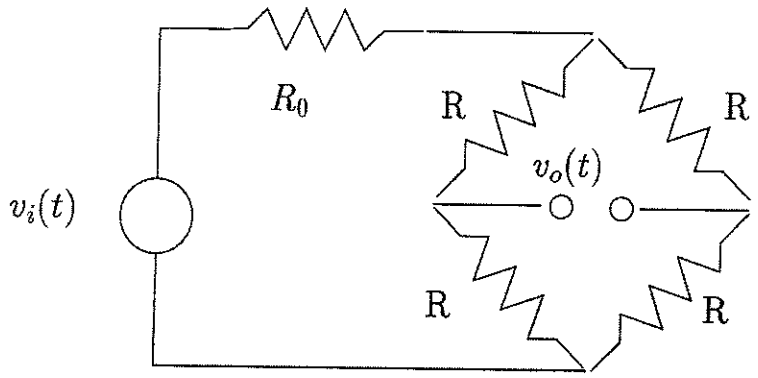
ECE C392 Modern Communication Technologies

Duration: 50 min Max. Marks: 40 Weightage: 20%

Answer all questions. All questions carry equal marks.

1. In a certain condition it is given that the rms thermal voltage developed across the series combination of two resistors R_1, R_2 is λ times that developed across the parallel combination of these two resistors.
   a) Determine the lower bound on λ if both resistors are at the same temperature.
   b) Find the relation required between R_1, R_2 to achieve this lower bound.

2. Find the mean-square thermal noise power, $\overline{v_0^2(t)}$, arising from the resistance bridge circuit shown below under the following limiting conditions: (a) $R_0 \to 0$, (b) $R_0 \to \infty$.



3. A certain amplifier has input and output resistances of 50Ω and a noise equivalent bandwidth of 140 kHz. When connected to a matched source and a matched load, the net gain is 50 dB. When a 50Ω resistor at 290K is connected to the input, the output rms noise voltage across 50Ω is 100 μV. Determine the equivalent noise temperature, T_e, of the amplifier.

4. A satellite at a distance of 40,000 kilometers transmits a signal at 12 GHz with an EIRP of 10 watts toward a 4.6 meter antenna that has an aperture efficiency of 60 percent. What is the received signal level at the antenna output?

======= Paper ends ======

BITS Pilani, Dubai Campus

B.E. (Hons.) ECE Third Year, Second Semester, 2011-2012

Test 1 (Closed Book)

ECE C392 Modern Communication Technologies

Duration: 50 min Max. Marks: 50 Weightage: 25%

Note: *Answer all questions. Appropriate assumptions can be made, where necessary.*

1. *The signal environment of a wireless system is hostile while that for a wired system is rather benign.* List any four points for each system in support of this statement. (6 marks)
2. Consider a simple binary communication system in which a binary zero is sent as zero volts and a binary one is sent as one volt. The transmitted voltage is corrupted by additive atmospheric noise. If the receiver receives anything above $\frac{1}{2}$ volt, it assumes that a *one* was sent. If it receives anything below $\frac{1}{2}$ volt, it assumes that a *zero* was sent. Measurements show that if one volt is transmitted, the received signal is random and has a Gaussian density with $m = 1$ and $\sigma = \frac{1}{2}$. Find the probability that a transmitted *one* will be interpreted as a *zero* at the receiver (i.e., find the probability of a *bit error*). Is this an acceptable level of performance? (Use the Q-function table provided overleaf). (10 marks)
3. Write a brief note on the ISM band. What does ISM stand for? (6 marks)
4. Define the term *bandwidth efficiency* as applied to digital modulation techniques. How is it measured? What is the maximum bandwidth efficiency that can be achieved for a noisy channel? (6 marks)
5. The term *matched-filter* is used synonymously with *correlator*. Explain, with appropriate mathematical expressions, how this is possible when their mathematical operations are different? (8 marks)
6. A market area for a cellular system is covered by 63 cells organized into 9-cell clusters. The system is allocated enough radio spectrum to support $N_{chan} = 800$ channels. Determine the percentage increase in the number of channels available to subscribers N_{market} if the cluster size is reduced to 7. What might limit reducing the cluster size still further? (8 marks)
7. Explain, with the help of a neat sketch, why a 5-cell frequency reuse cluster is not a valid configuration for cellular communication. (6 marks)

------ Paper ends ------

BITS Pilani, Dubai Campus
B.E. (Hons.) ECE Third Year, Second Semester, 2011-2012
Quiz 1 (Closed Book)
ECE C392 Modern Communication Technologies
Duration: 20 min Max. Marks: 16 Weightage: 8%

Name:- _____ ID No.:- _____

Answer all questions in the blanks provided against each question. Numerical answers should be supported with appropriate rough work in the space provided.

1. A mobile receiver in a wireless system has a sensitivity of -95 dBm. This corresponds to _____ Watt. As the receiver is moved in a local area, we wish to provide an 85% probability that the received signal will remain above the receiver sensitivity. What average received signal level is required? Express your answer either in Watt or dBm. Assume Rayleigh model. Ans. _____ (1 + 4 = 5 marks)
2. In multipath propagation, as the line-of-sight (LoS) component becomes large compared to the scattering components, the Ricean density function tends towards a _____ _____. However, when it becomes small, the density function tends to a _____ _____. (1 mark)
3. For a moving receiver, if the carrier frequency is 850 MHz and the receiver velocity is 70 miles per hour, what is the Doppler shift if the angle of the wave received from the base station antenna is 10°? Ans. _____ (4 marks)
4. The maximum throughput in pure Aloha is _____% while that in the slotted Aloha system is _____%. The unit for throughput is _____. (1.5 marks)
5. CSMA stands for _____. The "*p*-persistent" CSMA system is applied only to slotted systems. Here, if the channel is busy, the station waits until the _____ with a probability _____ and repeats the procedure. (2 marks)
6. _____, _____, and _____ are three major access techniques used to share the available bandwidth in a wireless communication system. (1.5 marks)
7. _____ the coded message before transmission and _____ after reception causes bursts of channel errors to be spread out in time and thus to be handled by the decoder as if they were random errors. (1 mark)

(Space for rough work. Use the other side of the sheet too, if required)