Sample Exam Paper for CCE 2112

Answer **all** questions in section A and **one** question from section B.

The student is allowed to be accompanied by the following text-book during this examination.

Mobile Communications, Jochen Schiller *2nd Edition*, ISBN 0-321-12381-6

2.5 hours

Section A

The following multiple choice questions will test your knowledge of concepts and fundamentals in communication systems.

Scoring for each question

Correct answer:	*3 marks*
Wrong answer:-	*-1 mark*
No answer:	*0 marks*

There is only one correct answer for each question.

Answer all questions in this section. The total mark for all questions is 60 and the minimum is 0.

1. The practical bandwidth for music that is band-limited to 18kHz and digitised into 16384 amplitude levels is approximately

    a. 1024kHz
    b. 38kHz
    c. 280kHz
    d. 600kHz
    e. 18kHz

2. Who of the following scientists confirmed empirically Maxwell's equations?

    a. James C. Maxwell
    b. Nikola Tesla
    c. Heinrich Hertz
    d. Michael faraday
    e. Gugliemo Marconi

3. A 20kbps PCM signal contains more information than an 80kHz bipolar square wave because

a. PCM is an old standard
b. The square wave is a periodic signal
c. PCM changes slowly with time
d. Bipolar signals perform better in noise
e. Information is inversely proportional to frequency

4. In a CATV system the power at a point is 5mW, where an in-line amplifier of gain 23dB is inserted. Calculate the power at the output port of the amplifier

a. 28dBm
b. 100mW
c. 1000W
d. 60dB
e. 30dBm

5. In a 2G cellular system the uplink control channel access protocol is based on the Aloha concept. This is because

a. All mobile terminals are exposed to each other
b. The strongest signal takes over the channel
c. Aloha has been designed for digital systems
d. The hidden terminal problem is not an issue
e. The base station is serving a thousand mobile phones

6. Telephone signals are sampled at 64kbps. Calculate the TDM data rate if 32 lines are time division multiplexed.

a. 1024Mmps
b. 2.048Mbps
c. 1024KHz
d. 2457.6kbps
e. 1228.8kHz

7. A particular switched cellular phone cell has 10 duplex voice channels installed. If the mean call holding time is 1.2 minutes and there are 300 incoming and outgoing calls per hour, calculate the probability of blocking.

a. 5%
b. 3.8%
c. 2%
d. 4.4%
e. 6.2%

8. This semester I have studied units in communication systems that concern the

a. Physical and Network layers
b. Data Link and Physical Layers
c. Data Link and Transport Layers
d. Data Link, Physical and Network Layers
e. None of the above

9. The duplexing method used in DECT is

a. TDD with 12 time slots for the uplink and downlink
b. TDD with 256 bits of encoded data per simplex link
c. TDMA with 24 slots per frame in 10ms
d. FDD with 2 time slots for uplink and downlink
e. CDMA with a 52µs chip time

10. Which name is most closely connected with the laying of the theoretical foundations in information theory:

a. John Von Neuman
b. Alan Turing
c. Claude E. Shannon
d. Godfried Ungerboek
e. Dauritius I. Tonnara

11. One reason for allocating Mobile communications to the lower GHz region is

a. Radio waves travel better at these frequencies
b. Electronics is low cost at these frequencies
c. The frequencies are close to those of a microwave oven
d. The mobile antenna is small enough at these frequencies
e. None of the above

12. Digital Terrestrial Broadcast Television operates in which of the following bands

a. VHF
b. FM
c. SHF
d. HF
e. None of the above

13. Worldwide telecommunications are regulated by

a. WRC

b. FCC
c. ITU
d. COE
e. ETSI

14. Which of the following does not contribute to multi-path propagation

a. Glass apertures
b. Trees
c. Scattering
d. Absorption
e. Buildings

15. Who pioneered frequency modulation during the first half of the 20th century?

a. Gugliemo Marconi
b. John L. Baird
c. Fredu Mallia
d. Edwin H. Armstrong
e. James C. Maxwell

16. The advantage of coherent 16-ASK over QPSK is;

a. Better immunity to noise
b. Simpler electronics
c. Lower Power consumption
d. Bandwidth efficiency
e. None of the above

17. A 64kbps PCM voice signal is first compressed by 75% and then fed into a channel 2/3 rate coder. The encoded signal modulates (QPSK) a 400MHz carrier. The Radio channel bit rate is;

a. 24kbps
b. 42.67kbps
c. 12kHz
d. 10.67kbps
e. 24kHz

18. Entropy coding is built upon

a. Signals that are Huffman encoded
b. The selective lack of change in a signal
c. Systems that can be lossy

d. Block parity systems
e. Type of noise in channel

19. Data transmission slots in a packet implicit reservation multiple access scheme are reserved using

a. A slotted Aloha scheme on the data transmission slot
b. A collision avoidance scheme on the data transmission slot
c. A pure Aloha scheme on the reservation slot
d. A carrier detection scheme on the reservation slot
e. A polling system on the reservation slot

20. An optical point-to-point link consists of a 4km cable (cable available in 1km lengths) and a receiver with a sensitivity of 15.0μW. The cable and connector attenuation constants are 5.0dB/km and 0.95dB/connector respectively. Calculate the transmitter output power required.

a. 2.88mW
b. 22.85dB
c. 4.6dB
d. 6.5dBm
e. 15.25dBm

Section B

Answer **one** question from this section. Total mark for **one** question is 40.

Question 1

a) Data encoded as a unipolar signal is used to amplitude modulate a 1GHz sinusoidal carrier. The data rate is 200kbits/sec.

i) Draw the circuit for the modulator and sketch its output in the time domain.

[4 marks]

ii) By first expanding the unipolar waveform as a fourier series of a square wave sketch the ASK waveform in the frequency domain.

[4 marks]

b) The ASK signal developed in (a) is transmitted over an AWGN channel.

i) Explain with a suitable diagram how channel random noise is modelled with statistical distributions of random variables.

[4 marks]

ii) Sketch the polar diagram for an ASK signal and using the model in (i) above show that there exists a crossover probability *p* that when a '1' is transmitted a '0' is received.

[4 marks]

c) The same ASK signal (in (a)) is now transmitted over an urban radio channel. The signal travels along four dominant paths, whose lengths are 4km, 8km 12km and 16km. Assume that the sequence 1000000… is transmitted.

i) Calculate the time taken for the data to travel along each of the four paths.

[4 marks]

ii) Sketch a diagram that shows the relative amplitude and sequence of the data received on each path and hence sketch the waveform at the receiver.

[8 marks]

iii) Using your diagram in (ii) describe the phenomena of inter-symbol interference with respect to an urban radio channel and describe one method to mitigate its effect.

[12 marks]

Question 2

In a given system the source data is organised in 7-bit words. In this question you will construct an error detection and correction code that is based on even parity.

a) Explain how even parity is used to detect a single error in a 7-bit data word.

[5 marks]

b) Explain how a set of 15 parity bits can be used to construct a code that can **detect** and **correct** errors.

[15 marks]

c) Calculate the code rate for the forward error correction code discussed in (b).

[5 marks]

d) Explain how you would set up an experiment in order to study the FEC properties of the code.

[15 marks]

Erlang B Traffic Table

Maximum Offered Load Versus B and N (B is in %)

N/B	**0.01**	**0.05**	**0.1**	**0.5**	**1.0**	**2**	**5**	**10**	**15**	**20**	**30**	**40**
1	.0001	.0005	.0010	.0050	.0101	.0204	.0526	.1111	.1765	.2500	.4286	.6667
2	.0142	.0321	.0458	.1054	.1526	.2235	.3813	.5954	.7962	1.000	1.449	2.000
3	.0868	.1517	.1938	.3490	.4555	.6022	.8994	1.271	1.603	1.930	2.633	3.480
4	.2347	.3624	.4393	.7012	.8694	1.092	1.525	2.045	2.501	2.945	3.891	5.021
5	.4520	.6486	.7621	1.132	1.361	1.657	2.219	2.881	3.454	4.010	5.189	6.596
6	.7282	.9957	1.146	1.622	1.909	2.276	2.960	3.758	4.445	5.109	6.514	8.191
7	1.054	1.392	1.579	2.158	2.501	2.935	3.738	4.666	5.461	6.230	7.856	9.800
8	1.422	1.830	2.051	2.730	3.128	3.627	4.543	5.597	6.498	7.369	9.213	11.42
9	1.826	2.302	2.558	3.333	3.783	4.345	5.370	6.546	7.551	8.522	10.58	13.05
10	2.260	2.803	3.092	3.961	4.461	5.084	6.216	7.511	8.616	9.685	11.95	14.68
11	2.722	3.329	3.651	4.610	5.160	5.842	7.076	8.487	9.691	10.86	13.33	16.31
12	3.207	3.878	4.231	5.279	5.876	6.615	7.950	9.474	10.78	12.04	14.72	17.95
13	3.713	4.447	4.831	5.964	6.607	7.402	8.835	10.47	11.87	13.22	16.11	19.60
14	4.239	5.032	5.446	6.663	7.352	8.200	9.730	11.47	12.97	14.41	17.50	21.24
15	4.781	5.634	6.077	7.376	8.108	9.010	10.63	12.48	14.07	15.61	18.90	22.89
16	5.339	6.250	6.722	8.100	8.875	9.828	11.54	13.50	15.18	16.81	20.30	24.54
17	5.911	6.878	7.378	8.834	9.652	10.66	12.46	14.52	16.29	18.01	21.70	26.19
18	6.496	7.519	8.046	9.578	10.44	11.49	13.39	15.55	17.41	19.22	23.10	27.84
19	7.093	8.170	8.724	10.33	11.23	12.33	14.32	16.58	18.53	20.42	24.51	29.50
20	7.701	8.831	9.412	11.09	12.03	13.18	15.25	17.61	19.65	21.64	25.92	31.15
21	8.319	9.501	10.11	11.86	12.84	14.04	16.19	18.65	20.77	22.85	27.33	32.81
22	8.946	10.18	10.81	12.64	13.65	14.90	17.13	19.69	21.90	24.06	28.74	34.46
23	9.583	10.87	11.52	13.42	14.47	15.76	18.08	20.74	23.03	25.28	30.15	36.12
24	10.23	11.56	12.24	14.20	15.30	16.63	19.03	21.78	24.16	26.50	31.56	37.78
25	10.88	12.26	12.97	15.00	16.13	17.51	19.99	22.83	25.30	27.72	32.97	39.44
26	11.54	12.97	13.70	15.80	16.96	18.38	20.94	23.89	26.43	28.94	34.39	41.10
27	12.21	13.69	14.44	16.60	17.80	19.27	21.90	24.94	27.57	30.16	35.80	42.76
28	12.88	14.41	15.18	17.41	18.64	20.15	22.87	26.00	28.71	31.39	37.21	44.41
29	13.56	15.13	15.93	18.22	19.49	21.04	23.83	27.05	29.85	32.61	38.63	46.07
30	14.25	15.86	16.68	19.03	20.34	21.93	24.80	28.11	31.00	33.84	40.05	47.74