Mansoura University
Dept. of Electrical Communications
and Electronics
Communications Theory 1
(COM9311)

Faculty of Engineering
Third year
3 hours exam
Final Exam
Jan. 2014

Two pages Exam

**Answer the following questions**
**All drawing should be drawn to scale with appropriate numbers if available**
**Assume any missing data, and make your assumptions clear**
**Use a carrier frequency of 900 MHz unless other values are given**
**Please answer each question at the beginning of a new page**
**Don't use red colors in answering**

**100 points**

**Q1)** Draw a block diagram for digital communications system, explain its operation, and what are the advantages of digital communications system over analog communications system? (10 points)

**Q2)** Find the exponential Fourier series and spectrum for a periodic square wave that equals '1' for $t \leq |\tau|$ and 0 otherwise where $\tau <$ the signal period T. (10 points)

**Q3)** design an AM broadcasting station with a total transmission power of 1000 Watts and a modulation index of 75% for tone modulation. For you design, estimate

(a) Average power of the modulated signal
(b) The station efficiency
(c) The peak amplitude of the output signal applied to 50 Ω antenna
(d) If the carrier power is kept constant and the total power is increased to 1100 Watts, what is the modulation index? (20 points)

**Q4)** With the aid of vector diagram compare between NBFM and DSB-LC (10 points)

**Q5)** A 100 MHz carrier is phase modulated by a sinusoidal signal f(t), the peak phase deviation is 2 radians, when the peak input amplitude is 3 volts. Find the ratio of the average power in the carrier to that in all sidebands excluding carrier and the bandwidth for each of the following cases using Carson's rule:

a) $1.5 \cos 2000\pi t$
b) $6 \cos 400\pi t$
c) $9 \cos 6000\pi t$

(15 points)

**Q6)** draw block diagrams for T.R.F and superhetrodyne receivers and explain their operations. State the advantages and disadvantages of each. (10 points)

**Q7)** Design an Armstrong indirect FM transmitter to generate FM signal with carrier frequency of 98.1 MHz, $\Delta f$=75 KHz. A narrowband FM is available at a carrier frequency of 100 KHz and a frequency deviation of $\Delta f$=10 KHz. The stock room has an oscillator with an adjustable frequency in the range of 10 to 11 KHz, and plenty of frequency multipliers. (15 points)

**Q8)** For the following circuit, $v_2(t)=a_1v_1(t)+a_2v_1(t)^2$ find:

a) Determine the spectral content of the output signal $v_2(t)$ (10 points)

b) How to generate AM signal from the output signal $v_2(t)$ (5 points)

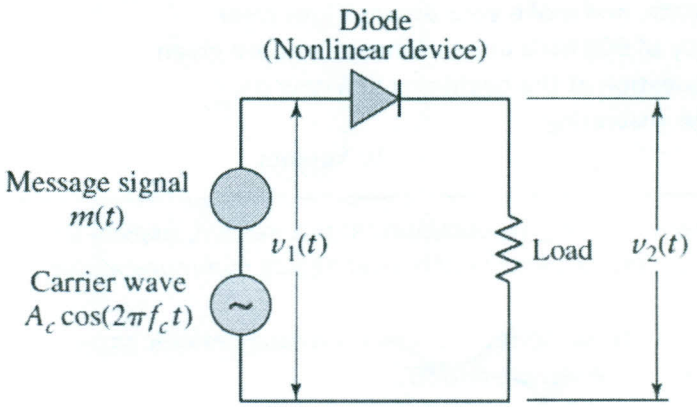


**TABLE A3.1** *Table of Bessel Functions*[a]

| | $J_n(x)$ | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| $n \backslash x$ | 0.5 | 1 | 2 | 3 | 4 | 6 | 8 | 10 | 12 |
| 0 | 0.9385 | 0.7652 | 0.2239 | −0.2601 | −0.3971 | 0.1506 | 0.1717 | −0.2459 | 0.0477 |
| 1 | 0.2423 | 0.4401 | 0.5767 | 0.3391 | −0.0660 | −0.2767 | 0.2346 | 0.0435 | −0.2234 |
| 2 | 0.0306 | 0.1149 | 0.3528 | 0.4861 | 0.3641 | −0.2429 | −0.1130 | 0.2546 | −0.0849 |
| 3 | 0.0026 | 0.0196 | 0.1289 | 0.3091 | 0.4302 | 0.1148 | −0.2911 | 0.0584 | 0.1951 |
| 4 | 0.0002 | 0.0025 | 0.0340 | 0.1320 | 0.2811 | 0.3576 | −0.1054 | −0.2196 | 0.1825 |
| 5 | — | 0.0002 | 0.0070 | 0.0430 | 0.1321 | 0.3621 | 0.1858 | −0.2341 | −0.0735 |
| 6 | | — | 0.0012 | 0.0114 | 0.0491 | 0.2458 | 0.3376 | −0.0145 | −0.2437 |
| 7 | | | 0.0002 | 0.0025 | 0.0152 | 0.1296 | 0.3206 | 0.2167 | −0.1703 |
| 8 | | | — | 0.0005 | 0.0040 | 0.0565 | 0.2235 | 0.3179 | 0.0451 |
| 9 | | | | 0.0001 | 0.0009 | 0.0212 | 0.1263 | 0.2919 | 0.2304 |
| 10 | | | | — | 0.0002 | 0.0070 | 0.0608 | 0.2075 | 0.3005 |
| 11 | | | | | — | 0.0020 | 0.0256 | 0.1231 | 0.2704 |
| 12 | | | | | | 0.0005 | 0.0096 | 0.0634 | 0.1953 |
| 13 | | | | | | 0.0001 | 0.0033 | 0.0290 | 0.1201 |
| 14 | | | | | | — | 0.0010 | 0.0120 | 0.0650 |

*Good Luck*
*Sherif Kishk*