



KOLEJ KEJURUTERAAN  
SEMESTER PERTAMA  
TAHUN AKADEMIK 2008/2009

**MID-SEMESTER EXAMINATION**

PROGRAM : SARJANA MUDA KEJURUTERAAN ELEKTRIK  
*PROGRAM*

MATAPELAJARAN : COMMUNICATION SYSTEM  
*SUBJECT*

KOD MATAPELAJARAN : EECB353/EEEEB453  
*SUBJECT CODE*

TARIKH : AUGUST 2008  
*DATE*

MASA : 1 ½ HOURS (inclusive reading time)  
*TIME*

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Arahan kepada calon:

1. Sila tulis nombor pelajar, seksyen dan nombor meja pada kertas jawapan.
2. Terdapat 3 soalan. Jawab SEMUA soalan.
3. Dilarang membawa bahan yang tidak dibenarkan semasa peperiksaan.

JANGAN BUKA KERTAS SOALAN INI SEHINGGA ANDA DIARAH BERBUAT  
DEMIKIAN

*Instructions to candidates:*

1. Please write your student ID, section and table number on the answer script.
2. There are 3 questions. Answer ALL questions.
3. Do not bring in unwarranted materials except those that are allowed.

**DO NOT OPEN THIS QUESTION PAPER UNTIL YOU ARE INSTRUCTED TO DO SO**

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KERTAS SOALAN INI MENGANDUNGI 5 MUKA SURAT BERCETAK TERMASUK  
MUKA SURAT INI.

*THERE ARE 5 PRINTED PAGES INCLUDING THIS PAGE IN THIS EXAMINATION  
PAPER.*

**Question 1 [20 marks]**

- a) When an AM transmitter is modulated with an audio testing signal the modulated signal produced is given by

$$s(t) = 100(1 + 0.64 \sin 3000\pi t) \sin 2.5 \times 10^6 t V.$$

Assume that the AM signal is fed into a  $50\Omega$  load, determine

- (i) The carrier frequency. [1 mark]
  - (ii) The modulating signal frequency. [1 mark]
  - (iii) The upper and lower side frequencies. [2 marks]
  - (iv) The peak amplitude of the carrier signal. [1 mark]
  - (v) The change in peak amplitude of the modulated wave. [1 mark]
  - (vi) The modulation percentage. [1 mark]
  - (vii) The upper side signal peak amplitude. [1 mark]
  - (viii) The maximum and minimum amplitudes of the envelope. [2 marks]
  - (ix) Sketch the AM waveform. (Label all pertinent voltages). [2 marks]
  - (x) Explain what happens to the bandwidth of AM if the frequency of the carrier signal is doubled? [2 marks]
  - (xi) If a perfect modulation occurs, calculate the percentage of power in each sideband. [2 marks]
- b) Draw a block diagram of an AM transmitter. [2 marks]
- c) A receiver uses low-side injection for the LO with an IF of 1750 kHz. The LO is operating at 15.75 MHz
- (i) To what frequency is the receiver tuned? [1 mark]
  - (ii) What is the image frequency? [1 mark]

**Question 2 [15 marks]**

For a 5 kHz sinusoidal modulating signal of amplitude 10 V, an FM broadcast-band transmitter produces a peak frequency deviation of 25 kHz. If a 7.5 kHz, 27 V modulating signal is applied to the modulator, determine,

- a) The modulation index. [2 marks]
- b) The number of side frequencies in a bandwidth  $\pm 50$  kHz centered on the unmodulated carrier frequency. [2 marks]

If the frequency of the modulating signal increases by a factor of 3, determine,

- c) The new peak frequency deviation and explain your result. [2 marks]
- d) The number of set of significant side frequencies. [2 marks]
- e) Determine the relative power of the carrier and side frequencies for a 10kW FM transmitter. [4 marks]
- f) Draw the power spectrum showing the relative amplitudes and frequencies. [3 marks]

**Question 3 [15 marks]**

a) A two-stage amplifier has a bandwidth of 236 kHz determined at its input and operates at 27°C. The first stage has a power gain of 8dB and noise figure of 2.4dB. The second stage has power gain of 40dB and noise figure of 6.5dB. The output is driving a load of 300Ω. In testing this system, the noise of a 100kΩ resistor is applied to its input.

- (i) Determine the system noise figure. [3 marks]
- (ii) Calculate the input noise voltage and power. [3 marks]
- (iii) Calculate the output noise voltage and power. [5 marks]

b) A receiver has a noise temperature of 100K.

- (i) What is the value of its noise figure? [2 marks]
- (ii) A competing company has a receiver with a noise temperature of 90K. Assuming its other specifications are equal, is this receiver better or worse than the one in part (i)? Explain your answer. [2 marks]

(Assuming Boltzmann's constant,  $K = 1.38 \times 10^{-23}$  J/K and reference temperature,  $T_o = 290$ K)

Bessel Function of the First Kind,  $J_n(m)$

Modulation Index m	Carrier	Side Frequency Pairs													
	$J_0$	$J_1$	$J_2$	$J_3$	$J_4$	$J_5$	$J_6$	$J_7$	$J_8$	$J_9$	$J_{10}$	$J_{11}$	$J_{12}$	$J_{13}$	$J_{14}$
0.00	1.00	—	—	—	—	—	—	—	—	—	—	—	—	—	—
0.25	0.98	0.12	—	—	—	—	—	—	—	—	—	—	—	—	—
0.50	0.94	0.24	0.03	—	—	—	—	—	—	—	—	—	—	—	—
1.00	0.77	0.44	0.11	0.02	—	—	—	—	—	—	—	—	—	—	—
1.50	0.51	0.56	0.23	0.06	0.01	—	—	—	—	—	—	—	—	—	—
2.00	0.22	0.58	0.35	0.13	0.03	—	—	—	—	—	—	—	—	—	—
2.40	0.00	0.52	0.43	0.20	0.06	0.02	—	—	—	—	—	—	—	—	—
2.50	-0.05	0.50	0.45	0.22	0.07	0.02	0.01	—	—	—	—	—	—	—	—
3.00	-0.26	0.34	0.49	0.31	0.13	0.04	0.01	—	—	—	—	—	—	—	—
4.00	-0.40	-0.07	0.36	0.43	0.28	0.13	0.05	0.02	—	—	—	—	—	—	—
5.00	-0.18	-0.33	0.05	0.36	0.39	0.26	0.13	0.05	0.02	—	—	—	—	—	—
5.45	0.00	-0.34	-0.12	0.26	0.40	0.32	0.19	0.09	0.03	0.01	—	—	—	—	—
6.00	0.15	-0.28	-0.24	0.11	0.36	0.36	0.25	0.13	0.06	0.02	—	—	—	—	—
7.00	0.30	0.00	-0.30	-0.17	0.16	0.35	0.34	0.23	0.13	0.06	0.02	—	—	—	—
8.00	0.17	0.23	-0.11	-0.29	-0.10	0.19	0.34	0.32	0.22	0.13	0.06	0.03	—	—	—
8.65	0.00	0.27	0.06	-0.24	-0.23	0.03	0.26	0.34	0.28	0.18	0.10	0.05	0.02	—	—
9.00	-0.09	0.25	0.14	-0.18	-0.27	-0.06	0.20	0.33	0.31	0.21	0.12	0.06	0.03	0.01	—
10.00	-0.25	0.05	0.25	0.06	-0.22	-0.23	-0.01	0.22	0.32	0.29	0.21	0.12	0.06	0.03	0.01