UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2012/2013

COURSE NAME	:	COMMUNICATION ENGINEERING
COURSE CODE	:	DAE 32603/ DEK 3233
PROGRAMME	:	3 DAE/DAL/DEE/DET
EXAMINATION DATE	:	OCTOBER 2012
DURATION	:	3 HOURS
INSTRUCTIONS	:	ANSWER **FOUR (4)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF SEVEN (7) PAGES

Q1 a) All electronic communication systems have the basic components that allow an electromagnetic wave travels from the source to the destination in a complete system. Using an appropriate block diagram, briefly explain four(4) primary components of an electronic communications

(8 marks)

b) Transmission medium is a method or material substance which can propagate waves or energy. Briefly explain and give an example of each the medium types below:-

i) Guided
ii) Unguided

(4 marks)

c) With reference to Table Q1(c), the Ultrahigh Frequencies (UHF) signal is transmitted from an antenna with Signal to Noise Ratio (SNR) of 20 dB.

Table Q1(c): Frequency Allocations

Designation	Frequency Range (Hz)
ELF	30 – 300
VF	300 – 3 K
VLF	3 K – 30 K
LF	30 K – 300 K
MF	300 K – 3 M
HF	3 M – 30 M
VHF	30 M -300 M
UHF	300 M – 3 G
SHF	3 G – 30 G
EHF	30 G – 300 G

i) State two(2) applications of UHF.
ii) Calculate the UHF bandwidth.
iii) What is the channel capacity of the signal?
iv) From your point of view, what happens to the channel capacity if the SNR is reduced to 5dB?

(8 marks)

d) Electronic communications are classified according to whether they are:

i) *Simplex* or *half-duplex* transmissions
ii) *Analog* or *digital* signals.

Define each of terms above.

(5 marks)

Q2 a) Briefly describe the process of amplitude modulation (AM). Sketch the modulating signal, carrier signal and AM signal.

(3 marks)

b) For the trapezoidal pattern shown in Figure Q2(b), determine:

i) Modulation coefficient, m.
ii) Percent modulation, M.
iii) Modulating amplitude, V_m.
iv) Carrier amplitude, V_C.
v) Upper and lower side frequency amplitude, V_{USB} and V_{LSB}.
vi) Frequency limit for upper and lower sideband (f_{USB} and f_{LSB}), if the carrier frequency, f_C =100kHz and the modulating frequency, f_m =5kHz.
vii) Bandwidth, BW.
viii) The total power of the AM wave, P_T, if load resistance $R_L = 10\ \Omega$.
ix) Draw the output spectrum for this AM DSBFC (Double Sideband Full Carrier).

(13 marks)

c) *Demodulator* or *detectors*, are circuits that accept modulated signals and recover the original modulating information.

i) Construct one(1) of the common AM demodulator circuit.
ii) According to answer in Q2(c)(i), explain how it works.

(5 marks)

d) TRF (Tuned Radio Frequency) receiver is the earliest and simplest receiver design. However there are some disadvantages of TRF receiver.

i) State the receiver that can overcome problems in TRF receiver.
ii) Give an advantage of the receiver as in Q2(d)(i).
iii) State two(2) main benefits of SSB(Single Sideband) over conventional AM.

(4 marks)

Q3 a) Describe two(2) reasons why modulation is necessary in electronics communication?

(2 marks)

b) Explain two (2) parameters to determine the performance of a receiver.

(2 marks)

c) An FM signal expressed as $V_{FM}(t) = 55\cos(2\pi 10^7 t + 2.5\sin 1256.64)$ is measured in a 72 ohm antenna. By referring to Table Q3(c), determine the following :

(i) Total power, P_T.
(ii) Modulation index, β.
(iii) Peak frequency deviation, Δf When time, t = 10ms.
(iv) Deviation sensitivity (kf), if 320mV is require to achieved part Q3(c)(iii).
(v) Amplitude spectrum voltages.
(vi) Bandwidth using Bessel table.
(vii) Approximate bandwidth by Carson's rule.
(viii) Sketch the FM signal spectra.

(15 marks)

d) What are the advantages and disadvantages of Frequency Modulation over Amplitude Modulation?

(2 marks)

e) 'PLL' is a type of FM demodulator circuits. All 'PLL' have three basic elements.

i) Give the meaning of 'PLL' acronym.
ii) Draw the block diagram of PLL elements.

(4 marks)

Q4 a) Noise may be defined as any unwanted introduction of energy tending to interfere with the proper reception and reproduction of transmitted signal. What is meant by the terms *external noise* and *internal noise*?

(4 marks)

b) List and describe the two (2) most significant forms of correlated noise.

(4 marks)

c) Determine the overall noise factor and noise figure for a three cascaded amplifiers as shown in Figure Q4 (c). Then, find the output Signal to Noise Ratio (SNR) in decibel (dB) at the final stage if the input SNR to the whole system is 35dB.

(11 marks)

d) Sketch and label a diagram summarizing the normal modes of propagation, which are the ground wave, the sky wave and the space wave.

(6 marks)

Q5 a) Transmission line consists of two conductors separated from one another by a dielectric which may be either air or some kind of plastic. Describe two(2) types of transmission line that commonly used.

(6 marks)

b) A coaxial cable has inductance of 32nH/m and capacitance of 120pF/m at 50MHz.The diameter of the inner conductor of the cable is 0.6 mm and the relative permittivity (ε_r) of the insulation is 2.23.

i) Calculate the line impedance of the cable.
ii) What is the outer conductor diameter?
iii) What is the velocity factor and propagation velocity for the cable?

(7 marks)

c) A 50 ohm load terminates a circuit as shown in Figure Q3 but it creates a mismatch with a standing wave ratio (SWR) of 1.44. A coaxial cable at a frequency of 10 MHz is used and it has the primary constants of,

$$C = 93.5 \text{ pF/m},$$
$$R = 0.8\ \Omega/\text{m},$$
$$G \approx 0$$

Determine:
i) the characteristic impedance and
ii) the propagation constant.

(6 marks)

d) Transmission line connects between a transmitter to the antenna or the antenna to the receiver. A perfect transmission line does not radiate any energy and does not have any losses. Briefly describe three(3) types of losses in transmission line.

(6 marks)

Q6 a) The characteristics of radio wave are almost similar to the light waves which are the reflection, the refraction and the diffraction. Explain briefly each of the characteristics mentioned.

(6 marks)

b) A radio wave moves from air ($\varepsilon_r = 1$) to glass ($\varepsilon_r = 5.8$) with angle of incidence 23^o. Assuming the relative permeability (μ_r) is unity, what is the angle of refraction? Then, find the critical angle.

(6 marks)

c) Antenna array is formed when two or more antenna elements are combined to form a single antenna. Antenna element is an individual radiator such as half or quarter wave dipole. *Driven* and *parasitic* are the two(2) types of element in antenna array.

i) Briefly explain each of them.
ii) Sketch the diagram of antenna array

(9 marks)

d) An antenna is to be installed to receive a LOS wave transmitted from a 0.15 km in height antenna located at a distance of 80,000m from this installation. Determine the necessary height of the receiving antenna in km.

(4 marks)

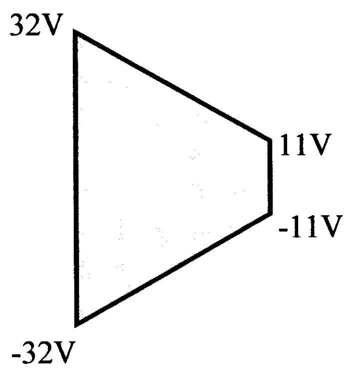

FIGURE Q2(b)

TABLE Q3(c): Bessel Function

Modulation index	Carrier J_0	Sidebands J_1	J_2	J_3	J_4	J_5	J_6	J_7	J_8	J_9	J_{10}
0.0	1.00	—	—	—	—	—	—	—	—	—	—
0.25	0.98	0.12	—	—	—	—	—	—	—	—	—
0.5	0.94	0.24	0.03	—	—	—	—	—	—	—	—
1.0	0.77	0.44	0.11	0.02	—	—	—	—	—	—	—
1.5	0.51	0.56	0.23	0.06	0.01	—	—	—	—	—	—
2.0	0.22	0.58	0.35	0.13	0.03	—	—	—	—	—	—
2.5	−0.05	0.50	0.45	0.22	0.07	0.02	—	—	—	—	—
3.0	−0.26	0.34	0.49	0.31	0.13	0.04	0.01	—	—	—	—
4.0	−0.40	−0.07	0.36	0.43	0.28	0.13	0.05	0.02	—	—	—
5.0	−0.18	−0.33	0.05	0.36	0.39	0.26	0.13	0.06	0.02	—	—
6.0	0.15	−0.28	−0.24	0.11	0.36	0.36	0.25	0.13	0.06	0.02	—
7.0	0.30	0.00	−0.30	−0.17	0.16	0.35	0.34	0.23	0.13	0.06	0.02
8.0	0.17	0.23	−0.11	−0.29	0.10	0.19	0.34	0.32	0.22	0.13	0.06

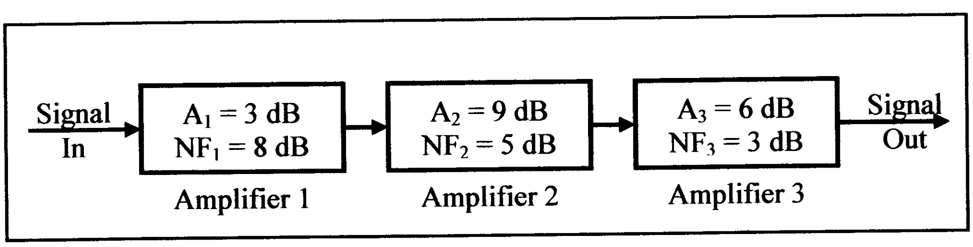

FIGURE Q4(c)

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FINAL EXAMINATION
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COURSE NAME	:	CHEMISTRY
COURSE CODE	:	DAS 12102 / DSK 1912
PROGRAMME	:	1 DAE 2 DAE 3 DAE / DET / DEE / DAL
EXAMINATION DATE	:	OCTOBER 2012
DURATION	:	2½ HOURS
INSTRUCTIONS	:	ANSWER **ALL** QUESTIONS IN **PART A** AND **TWO (2)** QUESTIONS IN **PART B**

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PART A

Q1 a) Based on the following half-reactions and E°_{red} values;

$$VO_2^{+}(aq) + 2H^{+}(aq) + e \rightarrow VO^{2+}(aq) + H_2O(l) \qquad E^{\circ}_{\mathrm{red}} = 1.00\ \mathrm{V}$$
$$Zn^{2+}(aq) + 2e \rightarrow Zn(s) \qquad E^{\circ}_{\mathrm{red}} = -0.76\ \mathrm{V}$$

i) Write the balanced redox equation representing the reaction occurs between VO_2^{+} and Zn^{2+}.
ii) Determine the anode and cathode of the system constructed in (i).
iii) Calculate $E^{\circ}_{\mathrm{cell}}$.

(11 marks)

b) A zinc-copper battery is prepared as follows:

$Zn(s)\ |\ Zn^{2+}(0.10\ \mathrm{M})\ ||\ Cu^{2+}(2.50\ \mathrm{M})\ |\ Cu(s)$

i) Determine the cell potential, $E^{\circ}_{\mathrm{cell}}$ when Zn/Zn^{2+} and Cu/Cu^{2+} react in standard condition.
ii) Calculate the cell potential E_{cell} of the zinc-copper battery at $[Zn^{2+}] = 0.10$ M and $[Cu^{2+}] = 2.50$ M.
iii) Evaluate the mass reduced from copper (Cu) electrode after 10.0 A of current flows within 10.0 hours.

($E^{\circ}_{Zn^{2+}/Zn} = -0.76$ V, $E^{\circ}_{Cu^{2+}/Cu} = +0.34$ V, 1F = 96500 C,
Relative Atomic Mass, Cu = 63.5)

(14 marks)

Q2 a) i) Write an expression for the dissociation constant K_a for the weak acid HX.
ii) For HX, $K_a = 4.25 \times 10^{-5}$ M. Calculate the pH of 0.45 M solution of this acid.

(10 marks)

b) The pH of 0.15 M solution of a weak acid, HA, is 2.82 at 300 K.

i) Write an expression for the acid dissociation constant, K_a, of HA.
ii) Determine the value of K_a for HA at 300 K and state its units.
iii) The dissociation of HA into its ions in aqueous solution is an endothermic process. How would its pH change if the temperature is increased? Explain your answer.

(15 marks)

PART B

Q3 a) Determine how many grams of sulfuric acid (H_2SO_4) solutes would be needed to make 250 mL of a 0.100 M solution.

(Relative Atomic Mass, H = 1, S = 32, O =16)

(6 marks)

b) Industrially, vanadium metal, V which is used in steel alloys, can be obtained by reacting vanadium (V) oxide, V_2O_5 with calcium (Ca) at high temperature. In this reaction, calcium oxide (CaO) will also be produced.

$$V_2O_5\,(s) \quad + \quad Ca\,(s) \quad \rightarrow \quad V\,(s) \quad + \quad CaO\,(s)$$

i) Balance the above equation.
ii) What mass of V_2O_5 is needed to produce 2.5 Kg of vanadium?

(Relative Atomic Mass, V = 50.9, Ca = 40, O =16)

(9 marks)

c) The balanced equation shows a complete decomposition reaction of 10.5 g of potassium chlorate.

$$2KClO_3(s) \rightarrow 2KCl(s) + 3O_2(g)$$

i) Calculate the number of moles of $KClO_3$ used in the reaction.
ii) Calculate the number of moles of oxygen gas produced.
iii) Compute the volume of oxygen gas produced at 1.00 atm and 25 °C.

(Relative Atomic Mass, K = 39.1, Cl = 35.5, O = 16,
R = 0.0821 L.atm $mol^{-1}.K^{-1}$)

(10 marks)

Q4 a) The electronic configurations of some elements K, L, M and N are given below.

(K) [Ne] $3s^2\ 3p^3$
(L) [Ne] $3s^2\ 3p^4$
(M) [Ne] $3s^2\ 3p^5$
(N) [Ar] $4s^1\ 3d^5$

i) Which element will be the most metallic? Explain your answer
ii) Draw orbital diagram for valence electron of K element.

(10 marks)

b) The values of ionization energy for elements of Na, Mg and Al are shown in Table Q4(b) below. Compare the values of ionization energies and explain.

Table Q4(b) : Ionization Energies of Na, Mg and Al

Element	Ionization energy ($kJ.mol^{-1}$)		
	E_1	E_2	E_3
Na	496	4,560	-
Mg	738	1,450	7,730
Al	57	1,816	2,744

(8 marks)

c) Define electronegativity. How does it vary across a period and down a group.

(7 marks)

Q5 a) i) Write the Lewis dot structure and show the formal charges for PO_3^{3-}
ii) Draw the resonance structure of NO_3^-

(Atomic number, Z: N = 7, P = 15, O = 8)

(10 marks)

b) Calculate the standard enthalpy change, ΔH^o, for the formation of 1 mol of strontium carbonate (the material that gives the red color in fireworks) from its elements.

$$Sr\,(s) + C(graphite) + \tfrac{3}{2}O_2(g) \rightarrow SrCO_3(s)$$

The information available is

$SrO\,(s) \rightarrow Sr\,(s) + \tfrac{1}{2}O_2(g)$	$\Delta H^\circ = +592$ kJ
$SrO\,(s) + CO_2\,(g) \rightarrow SrCO_3\,(s)$	$\Delta H^\circ = -234$ kJ
$CO_2\,(g) \rightarrow C(graphite) + O_2\,(g)$	$\Delta H^\circ = +394$ kJ

(15 marks)

Q6 a) Urea (NH_2CONH_2) is the end product in animal's protein metabolism. The decomposition of urea in 0.1 M HCl occurs according to the equation:

$$NH_2CONH_2(aq) + H^+(aq) + 2H_2O(l) \rightarrow 2NH_4^+(aq) + HCO_3^-(aq)$$

The reaction is first order in urea and first order overall.
When $[NH_2CONH_2] = 0.200$ M, the rate at 60.5 °C is 8.56×10^{-5} M/s

i) What is the rate constant, k?
ii) What is the concentration of urea in this solution after 4.00×10^3 s if the starting concentration is 0.500 M?
iii) What is the half-life for this reaction at 60.5 °C?
iv) How long will it take for the initial concentration to become one-third?

(15 marks)

b) Calculate K_c at 500 °C, given the equilibrium concentrations, 0.5 M hydrogen gas, 0.5 M chlorine gas and 1.5 M hydrogen chloride gas.

(Hint : write the balanced equation)

(10 marks)