COMMONWEALTH OF AUSTRALIA

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Warning

CHARLES DARWIN UNIVERSITY

Family Name	
Given Names	
Student Number	
Teaching Period	Semester 2, 2016

FINAL EXAMINATION	**DURATION**
ENG227 – Electromagnetics and Communication Technology	Reading Time: **10** minutes Writing Time: **180** minutes

INSTRUCTIONS TO CANDIDATES

The examination has 12 questions. Questions must be answered on the answer booklet.

This examination paper must not be removed from the exam room.

Read all questions carefully.

Show all working and units.

EXAM CONDITIONS

You may begin writing from the commencement of the examination session. The reading time indicated above is provided as a guide only.

This is an OPEN BOOK examination

Any calculator is permitted

Any handwritten material is permitted

Any hard copy, English dictionary is permitted (annotated allowed)

ADDITIONAL AUTHORISED MATERIALS	EXAMINATION MATERIALS TO BE SUPPLIED
Any printed material with the exception of CDU Library books	1 x 20 Page Book

THIS EXAMINATION IS PRINTED DOUBLE-SIDED.

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Question 1

The signal $x(t)=\cos 2\pi 100t+3\cos 2\pi 200t+2\cos 2\pi 400t$ is input to an LSSB amplitude modulation system with a carrier frequency of 10 kHz. Sketch the spectrum of the transmitted signal. Find the transmitted power S_T and bandwidth B_T.

(2 Marks)

Question 2

If a periodic signal has the even symmetry property $\upsilon(-t)=\upsilon(t)$ then the Fourier series coefficient is given by

$$c_n(t)=\frac{2}{T_0}\int_0^{T_0/2}\upsilon(t)\cos\left(2\pi nt/T_0\right)dt$$

Use this expression to find c_n when $\upsilon(t)=A\cdot\cos(2\pi t/T_0)$ for $|t|<T_0/2$.

(2 Marks)

Question 3

A given system has impulse response $h(t)$ and transfer function $H(f)$. Obtain expressions for the output signal $y(t)$ and $Y(f)$ when the signal into the system is $x(t)=A[\delta(t+t_d)-\delta(t+t_d)]$.

(2 Marks)

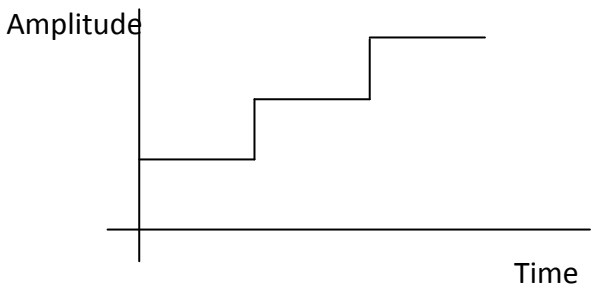
Question 4

Why are we interested in single sideband modulation rather than double sideband with carrier modulation? Which one of them can be simply demodulated using an envelope detector?

(2 Marks)

Question 5

Draw an amplitude modulated signal and a frequency modulated signal if an information signal has the following waveform.



(2 Marks)

Question 6

Consider a tone modulated frequency modulation signal with the signal amplitude A_m=1, the signal frequency f_m=20 kHz, β=1, the carrier amplitude A_c=100 and the carrier frequency f_c=40 kHz. Write an expression for the instantaneous frequency of the modulated signal.

(2 Marks)

Question 7

An optical fibre communication link is to be designed. A step index fibre is available which has a core diameter of 7 μm, a core refractive index of 1.46, and a cladding refractive index of 1.452. Can this fibre be used for single-mode operation if the transmitter wavelength is 1.3 μm?

(2 Marks)

Question 8

Briefly describe the two components of dispersion in single mode silica fibres. How can dispersion be minimised at a wavelength of 1.5 μm?

(2 Marks)

Question 9

(a) Why does the light generated by a LED have a wide spectral width? (b) What is the problem of having a wide spectral width optical source in an optical communication system?

(2 Marks)

Question 10

A semiconductor laser emitting light at a wavelength of 0.85 μm has an optical cavity of length 120 μm. The refractive index of the semiconductor is 3.5. Determine the wavelength separation between the longitudinal modes.

(2 Mark)

Question 11

A laser needs to satisfy two conditions in order to generate light. Discuss the two lasing conditions.

(2 Marks)

Question 12

The transfer function of a Mach Zehnder intensity modulator is given by

$$P_o = \frac{t_{ff}}{2} P_{in}\left(1+\cos\left(\pi \frac{V}{V_\pi}\right)\right)$$

(a) If the switching voltage V_π is 3 V, what is the bias voltage for the device to operate at the most linear region? (b) A small RF signal $V_{RF}(t)=V_{RF}\cdot\sin(\omega_{RF}t)$ and a DC bias voltage V_b = 1.5 V are applied to the modulator. Derive the output RF signal power expression for a modulator switching voltage of V_π = 3 V.

(3 Marks)