Charles Darwin University

Final Examination

Family Name						
Given Name/s						
Student Number						
Teaching Period	Semester 2, 2017					

ENG227 – Electromagnetics and Communication Technology	DURATION	
	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 a RESTRICTED OPEN BOOK examination

Any calculator is permitted

No handwritten notes are permitted

No dictionaries are permitted

ADDITIONAL AUTHORISED MATERIALS	EXAMINATION MATERIALS TO BE SUPPLIED
Lecture Notes (Annotated Permitted) Lecture Textbook/s (Annotated Permitted)	1 x 20 Page Book

THIS EXAMINATION IS PRINTED DOUBLE-SIDED.

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Question 1

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

(5 Marks)

Question 2

An information signal has 5 MHz bandwidth. What is the corresponding AM signal bandwidth? What is the corresponding DSB modulated signal bandwidth? A square law device is used to implement the modulation operation. What is the minimum carrier frequency so that the signal can be recovered at the receiver without distortion?

(3 Marks)

Question 3

What is tone modulation? Why are we interested in tone modulation in analysing an analogue communication system? Write an expression of a DSB without carrier tone modulated signal.

(3 Marks)

Question 4

The multitoned modulating signal $x(t)=2K(\cos 8\pi t+1)\cos 20\pi t$ is input to an DSB transmitter with f_c=1000 Hz. Find K so that $x(t)$ is properly normalized and draw the positive frequency spectrum of the modulated signal.

(5 Marks)

Question 5

Find the instantaneous phase $\phi(t)$, the instantaneous frequency $f(t)$, the maximum values of $\phi(t)$ and $f(t)$ for an information signal $x(t)=\cos 2\pi 100t$ undergoes PM.

(4 Marks)

Question 6

Briefly discuss various mechanisms that contribute to fibre loss, assuming the silica fibre has no impurities and no waveguide imperfections. Which mechanisms impose a fundamental limit on fibre loss?

(5 Marks)

Question 7

A single mode fibre has a core diameter of 8 μm and a refractive index of 1.46. The index difference is 0.003. The normalised frequency for an optical fibre is given by:

$$V = \frac{2\pi}{\lambda} a n_1 \sqrt{2\Delta}$$

What is the single mode cut-off wavelength of the fibre?

(3 Marks)

Question 8

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

(4 Marks)

Question 9

A semiconductor laser has a cavity length of 300 μm and a refractive index of 3.5. What is the frequency separation between the adjacent modes? What is the corresponding wavelength separation if the laser centre wavelength is 1.55 μm?

(4 Marks)

Question 10

(i) Why are single mode lasers rather than multimode lasers used in long distance optical communication systems?
(ii) Discuss one technique for longitudinal mode control.

(4 Marks)

Question 11

(i) Draw the structure of a Mach Zehnder intensity modulator.
(ii) Briefly discuss the operation principle of a Mach Zehnder intensity modulator.

(5 Marks)

Question 12

A photodiode has a quantum efficiency of 65% when photons of energy 1.5×10^{-19} J are incident upon it.
(i) At what wavelength is the photodiode operating?
(ii) Calculate the incident optical power required to obtain a photocurrent of 2.5 μA when the photodiode is operating as described above.

(5 Marks)