FIJI NATIONAL UNIVERSITY
College of Engineering, Science & Technology

SCHOOL OF ELECTRICAL & ELECTRONICS ENGINEERING

BACHELOR IN ELECTRONIC (Telecom & Networking) ENGINEERING

EEB761 – RADIO FREQUENCY PRINCIPLES

FINAL EXAMINATION – Semester 1, 2019

DURATION: 3 HOURS

TOTAL NO OF PAGES = 6

INSTRUCTIONS TO STUDENTS

1 You are allowed 10 minutes reading time during which you are **NOT** to write.

2 **BEGIN each QUESTION** on a fresh page and use both sides of the sheet.

3 Write your candidate number at the top of each attached sheet.

4 Insert all written foolscaps, graph paper etc. in their correct sequence and secure with a string.

5 For all sheets of paper on which rough/draft work has been done, cross it through and you must attach all of them to your answer scripts.

6 Write clearly the number(s) of the question(s) attempted on the top of each sheet.

8. **Attempt all questions**

9. **Total marks = 120**

Question 1. **[Total marks: 10]**

a) One of the most fundamental equations to all of Electromagnetics is the wave equation, which shows that all waves travel at a single speed- the speed of light.
Assume a source free region; ie no charges or currents are flowing. Derive the wave equation from Ampere's and Faraday's laws given the vector identity:

$$\nabla\times\nabla\times\mathbf{H}=\nabla(\nabla\cdot\mathbf{H})-\nabla^2\mathbf{H}$$

Question 2 **[Total marks: 20]**

a) Maxwell's Equations are a set of 4 equations that describe the world of electromagnetics. These equations describe how electric and magnetic fields propagate, interact, and how they are influenced by objects. Maxwell's Equations are laws - just like the law of gravity. List the point form of Maxwell's 4 equations and discuss their meanings.

Question 3. **[Total marks: 20]**

a) With the help of circuit diagrams together with frequency responses, discuss the properties and behaviours of resistors, capacitors and inductors when exposed at high frequencies. (15 marks)

b) Discuss your understanding on the "Electromagnetic Frequency Spectrum"? Comment on the wavelength as you move from low frequency to Gamma rays? (5 marks)

Question 4. **[Total marks: 10]**

a) The characteristic Impedance of a Transmission Line is given by the formulae:

$$Z_0 = \sqrt{\frac{R + j\omega L}{G + j\omega C}}$$

i) Derive the Characteristic Impedance Zo of both Lossless and Distortion-less Transmission Lines. (5 marks)

ii) A transmission line is said to be matched if the Characteristic Impedance Z_o is matched to the Load Z_L. Discuss the consequences if there is mismatch? (5 marks)

Question 5. **[Total marks: 10]**

a) The input impedance (Z_{in}) at any point on the transmission line is given by the formulae:

$$Z_{in} = Z_0 \left[\frac{Z_L + jZ_0 \tan \beta l}{Z_0 + jZ_L \tan \beta l} \right]; \beta = \frac{2\pi}{\lambda}$$

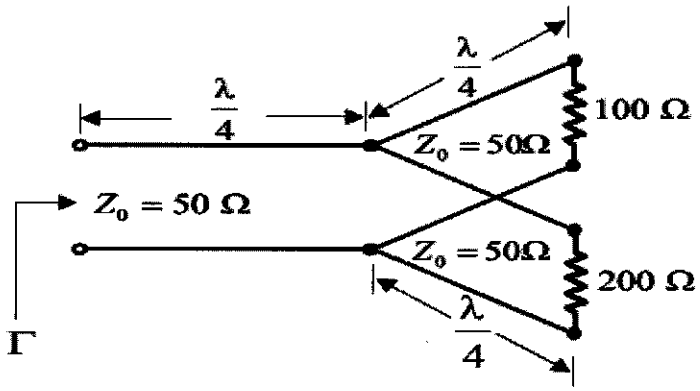
i) Derive the Input Impedance on the following:

- Open circuit at the Load
- Short Circuit at the Load
- When the line is a quarter wavelength from the Load Z_L.

Question 6. **[Total marks: 10]**

The parallel branches of a two wire transmission line are terminated in 100 ohms and 200 ohms resistors as shown in the figure below. The characteristic impedance of the line Z_0 is 50 ohms and each section has a length of $\lambda/4$.

Calculate the reflection coefficient "Γ" at the input?



Question 7 **[Total marks: 10]**

A 50 ohms transmission line is terminated to a load of 100 - 150j. The length of the line is 6.3 lamda.

i) Use Smith Chart to determine the following line parameters?
a) VSWR
b) Reflection Coefficient
c) Input Impedance
d) Input Admittance

Question 8 **[Total marks: 10]**

A 50 ohms lossless line is to be matched to a load of 20 – j15 ohms with a short circuit stub.

Use Smith Chart to find the following parameters:

a). The distance of the stub from the Load
b). Length of the stub
c). The load admittance
d). SWR at each segment

Question 9 **[Total marks: 10]**

a). Discuss the difference between amplitude modulation and frequency modulation and the reasons why signals are modulated? Use waveforms to illustrate your answer **(2.5 marks)**

b). Explain the differences of a Modulating signal (intelligence) and the Carrier and their relationship in terms of modulation index. **(2.5 marks)**

c).In AM, the output of the "modulator is the sum and difference of the two signals. Explain 3 reasons why SSB is normally used in AM transmission? **(2.5 marks)**

d). If the Carrier of an AM radio transmitter is 10KWatts and is 60% modulated, calculate the total power and the power of one side band. **(2.5 Marks)**

Question 10 **[Total marks: 10]**

Multiplexing is a process used in telecommunication system where millions of calls are placed in cables, long distance fiber optic and satellite to name a few.

i) Explain in your own words what multiplexing is and the advantages of multiplexing in telecommunication systems? **(3 marks)**

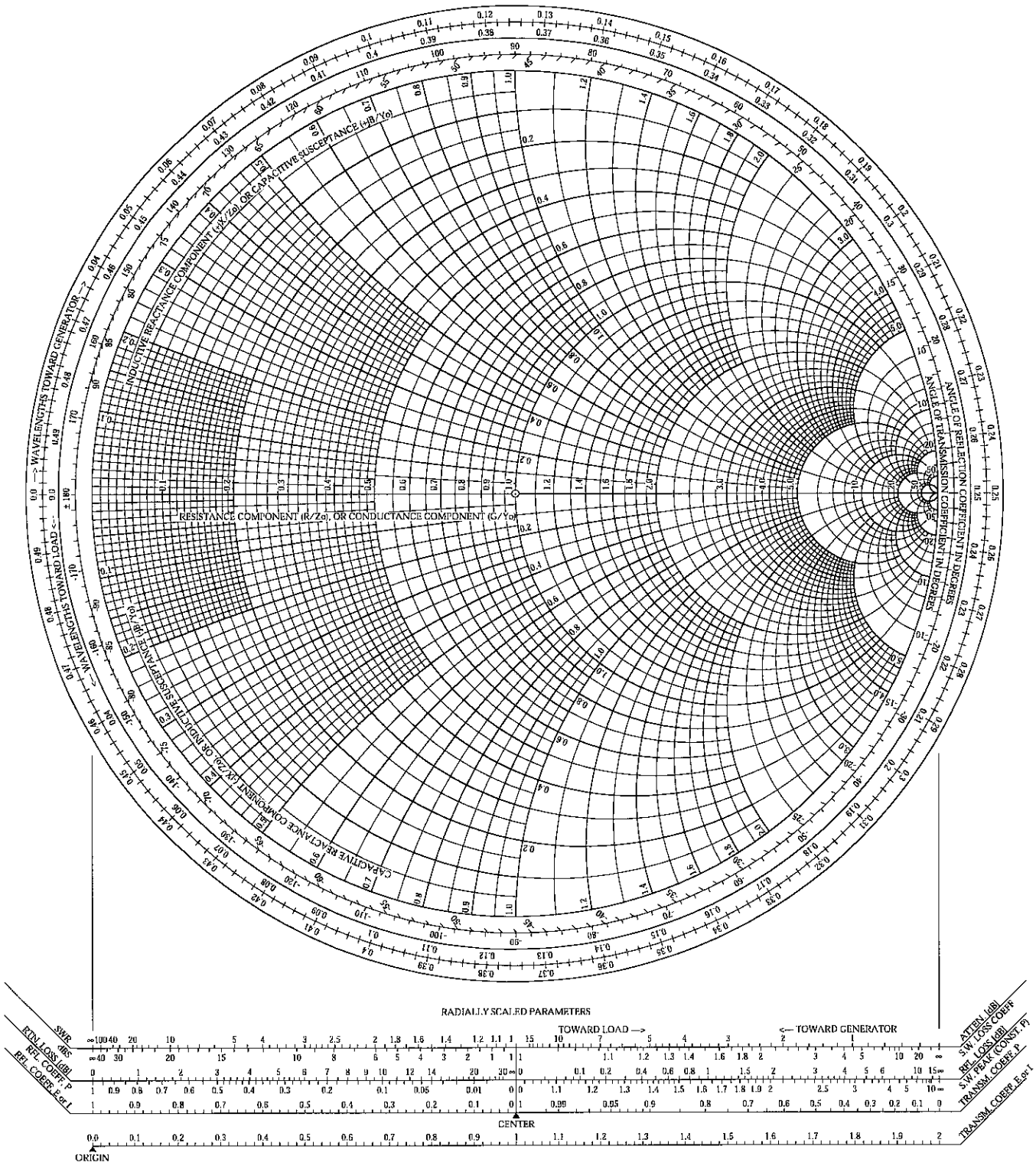
ii) Discuss the main differences between FDM and TDM **(4 marks)**

iii) From VF Band of 0.3 – 4 KHz, derive switch E1. **(3 marks)**

----------**The End**----------

The Complete Smith Chart

Black Magic Design



The Complete Smith Chart

Black Magic Design