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The Open University of Sri Lanka
Faculty of Engineering Technology
Department of Electrical and Computer Engineering

Study Programme	: Bachelor of Technology Honours in Engineering
Name of the Examination	: Final Examination
Course Code and Title	**: EEX5333/EEX5533 Communication Theory and Systems**
Academic Year	: 2021/22
Date	: 03rd March 2023
Time	: 0930-1230hrs
Duration	: **3 hours**

General Instructions

1. Read all instructions carefully before answering the questions.
2. This question paper consists of Section I and Section II.
3. Answer all the questions in Section I.
4. Answer only two questions from Section II.
5. Answers for each question should commence from a new page.
6. This is a Closed Book Test **(CBT).**
7. Answers should be in clear handwriting.
8. Do not use a red colour pen.

SECTION I

Question 1 **40 marks**

1) Derive an expression for the total power in a modulated wave of an amplitude modulator when there is more than one carrier signal for modulation. Apply the derived expression to obtain the total power when three sinusoidal carrier signals are involved in the modulation process. (10 marks)

2) Compare the operations of filter method and phase shift methods for single sideband suppression. In your answer, draw the relevant block diagrams and describe the relevant operations. (10 marks)

3) Compare the advantages of using emphasis for AM and FM. Calculate the value of 'f' and complete the given Figure 1 for a 75μs emphasis system. (10 marks)

4) Plate dissipation power of a Class C amplifier is 944 W with a modulation index of 0.6. Efficiency of the power amplifier is 70%. Efficiency of the modulator is 30%. Calculate the following: (10 marks)
   a. Carrier signal power when the modulation depth is 100%
   b. Plate dissipation power when the modulation depth is 100%

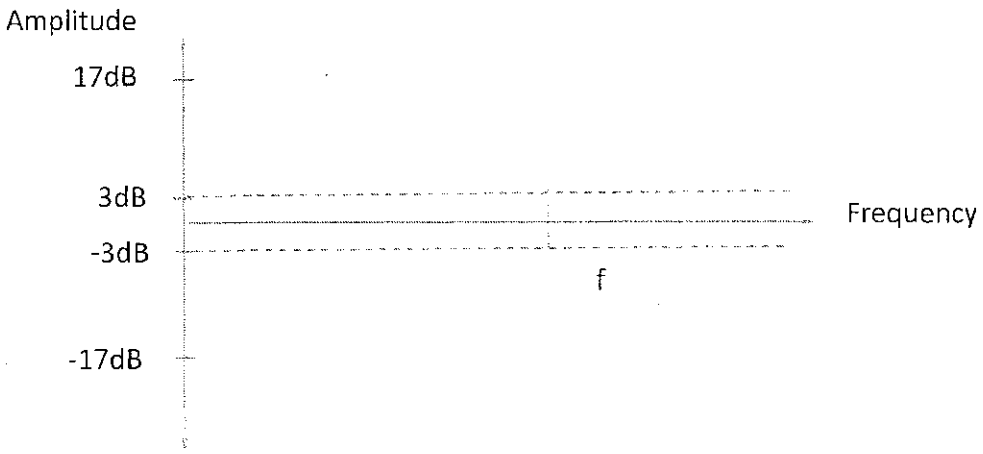

Figure 1

SECTION II

Question 2

1) Describe the general frequency response curve of the Foster-Steely phase discriminator. Draw the circuit diagram to support your answer. (08 marks)

2) Considering a phase modulated FM transmitter state whether the following statements are true/false and support your answer with reasons. (06 marks)
   a. Harmonic generators help to reduce both the frequency distortion and noise impairments in the FM signal.
   b. Phase modulated FM transmitters are most suitable to generate large frequency deviations.

3) Discuss whether the modulation index will be affected by any changes in the frequency changing of the modulated signal of an Armstrong frequency modulator. (06 marks)

Question 3

1) Draw the phasor diagrams for the (i) amplitude modulated signal and (ii) output signal when the carrier is removed from the modulated signal of an Armstrong frequency modulator. (04 marks)

2) Discuss how the frequency stabilization is achieved in a reactance type FM modulator. (03 marks)

3) Consider a FM receiver which has an IF amplifier followed by a phase discriminator. The effective deviation of the FM signal is 80kHz. The IF amplifier has a 3dB power loss at 60kHz around the intermediate frequency. If the modulating frequency is 10kHz, draw the IF gain characteristic, discriminator output waveforms and the type of distortion present. (10 marks)

Question 4

1) Derive an expression for the characteristic impedance of a transmission line considering the general equivalent circuit with elements R, G, L and C. (06 marks)

2) Calculate the minimum value of the characteristic impedance of an air dielectric parallel wire line. Clearly state any assumption you make in the calculation. (04 marks)

3) Consider a coaxial cable with an inner diameter of 0.001 inches and an insulator with a dielectric constant of 2.7 and characteristic impedance of 78Ω. Calculate the outer diameter of the conductor. (04 marks)

4) a) Discuss the standing wave losses in short-circuited transmission line of finite length. Support your answer with relevant diagrams. (04 marks)

b) Calculate the characteristic impedance of a quarter wave transformer when a load of 300Ω need to be matched to a transmission line with a characteristic impedance of 200Ω. (02 marks)

Question 5

1) Discuss three requirements that need to be satisfied by an antenna coupler when used between the transmitter and the antenna. (06 marks)

2) Compare the variation of input impedance of a closed-circuited and open-circuited transmission lines as a function of length in a transmission line. (06 marks)

3) Design a reactive T-section to match a load of $(350 + j\,220)k\Omega$ to an 1000Ω generator at $\omega = 2.5\times10^{6}\,rad/sec$, using critical coupling. (08 marks)