BINDURA UNIVERSITY OF SCINCE EDUCATION

FACULTY OF SCIENCE EDUCATION

DEPARTMENT OF ENGINEERING AND PHYSICS

Bachelor of Science Honours Degree in Electronic Engineering

EEE5203 - COMMUNICATION SYSTEM PEFORMANCE EXAMINATION

Duration: 3 Hours **Total Marks: 100**

Special Requirements: Non Programmable Scientific Calculator

INSTRUCTIONS

1. Answer any **FIVE (5)** questions
2. This paper contains **SEVEN (7)** questions
3. Each question carries 20 marks

APR 2025

Constants

$Boltzmann's\ constant\ k = 1.38 \times 10^{-23} J/K$

1(a) Define the following terms.

(i) dBm

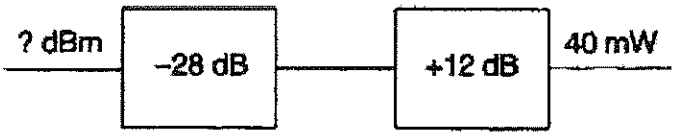
(ii) dBi

(iii) dBd **[6]**

(b) Derive the formulae of voltage and current gain in decibels without any assumptions. **[6]**

(c) An amplifier has a gain of 45,000, which is too much for the application. With an input voltage of 20 μV, what attenuation factor is needed to keep the output voltage from exceeding 100 mV? **[3]**

(d) What is the indicated missing value in the cascaded circuits below? **[3]**



(d) Explain the significance of impedance matching in communications systems. **[2]**

2(a) A receiver with a 75-V input resistance operates at a temperature of 31°C. The received signal is at 89 MHz with a bandwidth of 6 MHz. The received signal voltage of 8.3 μV is applied to an amplifier with a noise figure of 2.8 dB.

Find

(i) the input noise power **[3]**

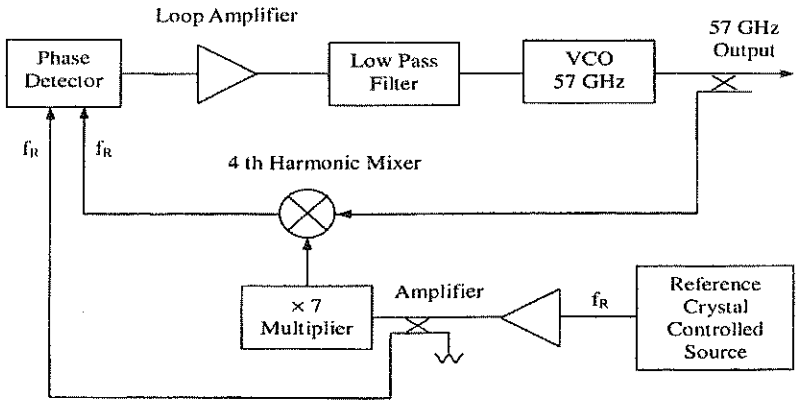
(ii) the input signal power **[2]**

(iii) S/N, in decibels **[2]**

(iv) the S/N of the amplifier **[3]**

(b) What is the significance of Noise figure **[2]**

(c) A 57-GHz phase-locked source has the block diagram shown below . Determine the reference signal frequency(f_R). The reference source is a crystal-controlled microwave oscillator. If the reference source has a frequency stability of $\pm 1\ ppm/°C$, what is the output frequency variation? **[4+4]**



A 57-GHz phase-locked

3(a) Describe **four** primary coefficients of a transmission line. **[3+3+3+3]**

(b) Define characteristic impedance of a transmission line **[1]**

(c) A loss free transmission line has distributed inductance of 1.2 mH/km and a distributed capacitance of 0.5 μ F/km.

(i) Calculate characteristic impedance Z_0 **[1]**

(ii) Propagation constant γ of the line. **[2]**

(d) For a 0.4 km section of the above line find

(i) the frequency at which the line length is equivalent to one wavelength **[2]**

(ii) the velocity of propagation. **[2]**

4(a) Describe the source and characteristics of the following types of noises

(i) Thermal noise **[3]**

(ii) Flicker noise **[3]**

(ii) Shot noise **[3]**

(b) State three ways of dealing with each of the following types of noise

(i) External noise **[3]**

(ii) Internal noise **[3]**

(c) A loss-free 100Ω transmission line is terminated in a load 80+j60 Ω. We wish to analyse various aspects of the performance of the line.

(i) Determine the voltage reflection coefficient. **[2]**

(ii) Determine the voltage standing wave ratio. **[3]**

5(a) Sketch a circuit of a low-pass RC filter: **[3]**

(ii) Why do we need to use a capacitor in this circuit? Explain. **[3]**

(iii) Explain how the circuit filters (selects) the signals. **[3]**

(iv) Sketch frequency response of a low pass filter. **[3]**

(v) Sketch attenuation versus frequency graph. **[3]**

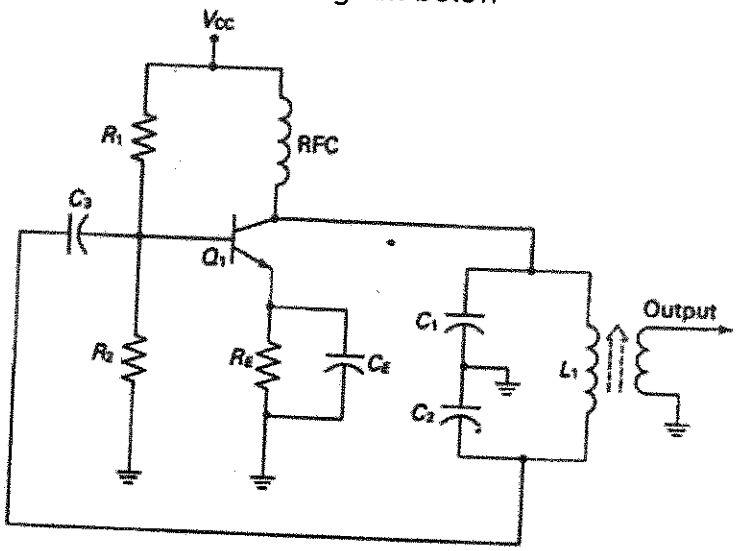
(b) A BPF is built from an HPF whose f_{C1} = 10 kHz and an LPF whose f_{C2} = 12 kHz:

(i) What is the passband? **[1]**

(ii) What is the bandwidth of this BPF? [1]

(iii) What can you do to increase (or decrease) the passband of a BPF? The bandwidth of a BPF? [3]

6 Referring Colpitts Oscillator circuit diagram below



Assume it is desired to design the oscillator so that its oscillating frequency is 4 MHz. If $L_1 = 50\mu H$, and the feedback fraction $\beta = \frac{1}{20}$, calculate

(a) required value of equivalent tank capacitance $\left(C_{eq} = \frac{1}{C_1} + \frac{1}{C_2}\right)$ [4]

(b) The required value of C_1 and C_2 [3+3]

(c) Minimum voltage gain A_V required for the CE amplifier to sustain oscillations [3]

(d) State Barkhausen Criterion. [4]

(e) Explain the significance of Shannon-Hartely Law in Telecommunication. [3]

7(a) A free-space LOS microwave link operating at 10 GHz consists of a transmit and a receive antenna each having a gain of 25 dB. The distance between the two antennas is 30 km and the power radiated by the transmit antenna is 10 W.

Calculate the path loss of the link and the received power. [5+6]

(b)(i) State the significance of mathematical models in the design of communication systems. [2]

(ii) State the mathematical model of a wireline telephone channel that is affected by attenuation and define parameters in the equation. [3]

(iii) Represent the mathematical model in block diagram form. [2]

(c) State Shannon coding theorem [2]

END OF PAPER