26/06/2025

Course Title: Microwave and Satellite Communication

Department of Computer Science and Telecommunication Engineering
Year 3, Term 2, Final Examination (May 2025), Session 2020-21
Course Code: **CSTE 3203**, Full Marks: 70, Time: Four hours
*Answer any **SEVEN** of the following questions.*

1.a)	Write the frequency range for **L**-band and **C**-band.	2
)	If a transmission line is terminated with a resistance equal to its characteristic impedance- what will happen?	3
c)	A transmission line having 50 Ω impedance is terminated in a load of (40+j30) Ω. Calculate VSWR.	2
d)	Calculate the input impedance of short circuited quarter wavelength lossless transmission line.	3
)	Write the working principles of parabolic reflector.	2
)	Describe the driven elements for parabolic reflector.	5
c)	If aperture length (H-plane) 125mm, aperture width (E-plane) 100mm and operating wavelength 30mm for a horn antenna, then calculate the antenna gain in dB.	3
)	For a given antenna, electric field is $E(\theta) = Sin\theta$. Calculate HPBW and FNBW.	3
)	Draw the block diagram of microwave transmitter.	3
)	If the operating frequency is 1 MHz, then calculate the antenna size for a dipole antenna.	2
)	Calculate the antenna gain if the aperture area is 20 m^2, the wavelength is 2 m, and the efficiency is 80%. Convert the calculated gain into dB.	2
)	Describe the working principle of a moving target indicator radar system.	3
b)	Derive RADAR range equation.	4
)	Calculate the maximum range of the radar when power transmitted by the radar is 250KW, transmitting antenna gain is 4000, effective aperture of the receiving antenna is 4 m^2, radar cross section of the target is 25 m^2 and power of the minimum detectable signal is 10^{-12} W.	3
5.a)	Write down the functional block diagram of an earth station and explain how signal is processed for transmission and reception.	5
b)	What is transponder? Explain the block diagram of single conversion transponder.	3
c)	A satellite is orbiting in the equatorial plane with a period from perigee to perigee of 12 hours. Given that the eccentricity is 0.002, calculate the semi major axis. The earth's equatorial radius is 6378.1414 Km	2
6.a)	A pseudo random sequence is generated using a feedback shift register of length m=4. The chip rate is 10 chips per second. Find the following x) PN sequence length y) Chip duration of PN sequence z) PN sequence period.	3
b)	Compare FDMA, TDMA and CDMA.	3
c)	Discuss TDMA time synchronization.	4
7.a)	Derive the impedance transformation relation for transmission line and explain three important characteristics.	4
b)	What is VSWR? Explain the importance of VSWR in transmission line.	3
c)	A transmission line has L=0.25μH/m, C=100pF/m and G=0. What should be the value of R for the line so that the line can be treated as low-loss line? The frequency of propagation is 100MHz.	3

8.a) Define: ascending node, perigee, line of apsides and inclination angle. 4

b) Write Kepler's 2nd law. 2

c) A satellite wishes to orbit the earth at a height of 100 Km above the surface of the earth. Determine the speed, acceleration and orbital period of the satellite. (Given M_{earth}= 5.98 x 10^{24}kg and R_{earth}= 6.37 x 10^{6}m). 4

a) Derive the equation of received power by the earth station from the satellite. 3

A satellite at a distance of 39,000 km from the CSTE departmental building radiates a power of 20 W from an antenna with a gain of 22 dB in the direction of a VSAT at the CSTE building with an effective aperture area of 10 m^2. Calculate the power received by the VSAT antenna 5

c) A satellite downlink at 12 GHz operates with a transmit power of 20W and an antenna gain of 45 dB. Calculate effective isotropic radiated power in dBW. 2