



VIT[®]

Vellore Institute of Technology
(Deemed to be University under section 3 of the UGC Act, 1956)

Reg. No. : **21BEC1851**

Final Assessment Test(FAT) - Nov/Dec 2024

Programme	B.Tech.	Semester	Fall Semester 2024-25
Course Code	BECE310L	Faculty Name	Prof. Niraj Kumar
Course Title	Satellite Communications	Slot	B1+TB1
		Class Nbr	CH2024250100027
Time	3 hours	Max. Marks	100

General Instructions

- Write only Register Number in the Question Paper where space is provided (right-side at the top) & do not write any other details.

Course Outcomes

1. Analyse the concept of orbits, launch vehicles and satellites
2. Comprehend the design of satellite subsystems
3. Imbibe the basics of digital transmission related to satellite communication
4. Analyse the navigation satellite services.
5. Analyse the impact of diverse parameters on satellite link design
6. Apply the satellite systems for various applications

Section - I

Answer all Questions (1 × 10 Marks)

***M - Marks**

Q.No	Question	*M	CO	BL
01.	(a) A satellite is in an elliptical orbit with a perigee of 1000 km and an apogee of 4000 km. Using a mean earth radius of 6378.14 km, find (i) The period of the orbit in hours, minutes, and seconds [2 Marks] (ii) eccentricity of the orbit [2 Marks] (b) Describe the various orbital effects on communication system performances. [6 Marks]	10	1	1

Section - II

Answer all Questions (6 × 15 Marks)

***M - Marks**

Q.No	Question	*M	CO	BL
02.	A link is established through a GEO satellite at longitude 30°W between an earth station near Rio de Janeiro, Brazil, and an earth station near Santiago, Chile. The coordinates of the earth stations are: Rio de Janeiro: Latitude 22.91°S, longitude 43.17°W Santiago: Latitude 33.45°S, longitude 70.67°W Calculate the elevation and azimuth angle of the satellite from both earth stations and determine whether the satellite is visible from the earth stations.	15	1	3

03. (a) Describe the fundamental working principle of the Altitude and Orbit Control (AOC) subsystem of a satellite system along with a block diagram. [7 Marks] 15 2 3
- (b) A large GEO satellite requires a total of 12 kW to operate its communication systems and 1.5 kW for housekeeping purposes. The longest duration of an eclipse is 70 minutes in spring and fall during which time the battery provides the required power to keep the satellite operating. The battery voltage is 50V and the batteries must not discharge more than 50% during the eclipse.
- (i) Calculate the battery capacity required in ampere hours (AHs). A battery with a capacity of one ampere hour can supply one amp for one hour. [4 Marks]
- (ii) If lithium-ion batteries with a capacity of 200 watt hours per kilogram are used, find the weight of the battery. [4 Marks]
04. (a) Explain the principle behind spectrum spreading and despreading and how this is used to minimize interference in a CDMA system. [7 Marks] 15 3 3
- (b) A TDMA network of seven earth stations shares a single transponder equally. The frame duration is 2.0 ms, the overhead time per station is 30 μ s, and guard bands of 5 μ s are used between bursts. Transmission bursts are QPSK at 40 Mbps.
- (i) Calculate the number of 64 kbps channels that each TDMA earth station can transmit. What is the efficiency of the TDMA system? [4 Marks]
- (ii) If the frame length is increased to 20ms, what is the new TDMA system efficiency? [4 Marks]
05. A C-band earth station has an antenna with a transmit gain of 50 dB. The transmitter output power is set to 120 W at a frequency of 6.5 GHz. The signal is received by a satellite at a distance of 38,500 km by an antenna with a gain of 27 dB. The signal is then routed to a transponder with a noise temperature of 500 K, a bandwidth of 36 MHz, and a gain of 110 dB. 15 5 5
- (a) Calculate the path loss at 6.5 GHz. [3 Marks]
- (b) Calculate the power at the output port (sometimes called the output waveguide flange) of the satellite antenna, in dBW. [3 Marks]
- (c) Calculate the noise power at the transponder input, in dBW, in a bandwidth of 36 MHz. [3 Marks]
- (d) Calculate the C/N ratio, in dB, in the transponder. [3 Marks]
- (e) Calculate the carrier power, in dBW and in watts, at the transponder output. [3 Marks]
06. (a) What is leapfrog technology? Explain with suitable examples. [8 Marks] 15 6 2
- (b) Why is TDMA preferred in the VSAT network? [7 Marks]
07. What is GPS technology, and how does it utilize satellite communication to provide precise location, navigation, and timing services? Explain the working principles of GPS, its components, and key applications in various sectors 15 4 2

BL-Bloom's Taxonomy Levels - (1.Remembering, 2.Understanding, 3.Applying, 4.Analysing, 5.Evaluating, 6.Creating)

