Reg. No. : | | | | | | | | | | | |

Question Paper Code : 80722

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2025.

Fifth/Sixth/Seventh/Eighth Semester

Electronics and Communication Engineering

CEC 352 – SATELLITE COMMUNICATION

(Common to Electronics and Telecommunication Engineering)

(Regulations 2021)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. Give the importance of Kepler's second law.

2. Why is station keeping important?

3. What is the function of the transponder in a satellite?

4. Why is an omnidirectional antenna essential for a satellite's telemetry?

5. What is system noise temperature?

6. What is free space path loss?

7. Mention the advantages of TDMA over FDMA.

8. How does encryption take place in satellite communication?

9. Define dilution of precision in GPS.

10. Mention the importance of VSAT.

PART B — (5 × 13 = 65 marks)

11. (a) Derive the equations to calculate the elevation angle for a satellite.

Or

(b) A ground station located at mean sea level is positioned at a latitude of 35.75° north and a longitude of 120.95° west. Assuming a minimum elevation angle of 10°, calculate the satellite's visibility limits in terms of longitude.

12. (a) Explain the main subsystems of a satellite. Discuss how thermal control and AOCS are implemented. (6 + 7)

Or

(b) (i) Explain in detail the functions and characteristics of onboard transponders and bent-pipe transponders. (8)

(ii) Discuss the importance of power amplifiers in satellite transponder systems. (5)

13. (a) Derive the link budget equation for both uplink and downlink. Discuss the significance of each term. (9 + 4)

Or

(b) A satellite transmits a QPSK-modulated signal using a raised cosine filter with a roll-off factor of 0.35. The target bit error rate (BER) is 10^{-6}. The downnlink path loss is estimated to be 198 dB, the G/T value of the receiving earth station is 30 dBK, and the available transponder bandwidth is 27 MHz. Calculate:

(i) The maximum bit rate that can be supported within the given bandwidth. (6)

(ii) The Effective Isotropic Radiated Power (EIRP) required to achieve the specified BER. (7)

14. (a) Compare FDMA, TDMA, and CDMA techniques in terms of bandwidth efficiency, complexity, and interference.

Or

(b) Illustrate the procedure of forward error correction using block and convolutional codes.

15. (a) Explain the architecture and features of INSAT and INTELSAT systems.

Or

(b) Discuss how GPS and Differential GPS differ in operation, accuracy and applications.

PART C — (1 × 15 = 15 marks)

16. (a) (i) A dual-stage up-converter system is used for satellite uplink with the following parameters: Uplink frequency range = 13.75 to 14.25 GHz, First intermediate frequency (IF1) = 120 MHz, Carrier bandwidth = 54 MHz, Band-Pass Filter 1 (BPF1) center frequency = 1.25 GHz Determine the following:

(1) The first local oscillator frequency,

(2) The range of the second local oscillator frequency,

(3) The frequency spectrum of the unwanted sidebands,

(4) The bandwidths passed by BPF1 and BPF2 that eliminate those sidebands. (8)

(ii) With appropriate mathematical expressions, explain the design principles of an uplink chain using dual up-conversion. (7)

Or

(b) A 13.5 GHz uplink is used for satellite communication, where the total uplink losses and link margin amount to 208 dB. The satellite has a G/T ratio of 12 dB/K, and the required E_b / N_0 for reliable transmission is 10 dB.

(i) Assuming FDMA is used and the uplink earth station antenna gain is 48 dB, determine the transmitter power needed to support the transmission of a 2 Mbps digital signal. (5)

(ii) If the same satellite is now used for TDMA transmission at a peak data rate of 85 dBb/s, calculate the additional uplink power required compared to FDMA operation. (5)

(iii) Discuss how the choice of multiple access technique (FDMA vs TDMA) influences the power budget and system complexity of the uplink. (5)