Reg. No. :

Question Paper Code : X10347

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2020
AND APRIL/MAY 2021
Fifth/Seventh/Eighth Semester
Geoinformatics Engineering
EC 8094 – SATELLITE COMMUNICATION
(Common to Electronics and Telecommunication Engineering, Electronics and Communication Engineering)
(Regulations 2017)

Time : Three Hours | Maximum : 100 Marks

Answer ALL questions

PART – A **(10×2=20 Marks)**

1. A satellite is in an elliptical orbit with eccentricity of 0.6 and perigee altitude 1000 Km. Determine :
   a) The semi major axis
   b) The period of revolution
2. Assume a circular orbit : Using Newton's law of gravitation and Newton's second law, determine the acceleration of a satellite.
3. Define payload and transponder.
4. Draw the block diagram of antenna subsystem.
5. Explain what is meant by noise factor.
6. Calculate the effective area of a 10-ft parabolic reflector antenna at a frequency of (a) 4 GHz (b) 12 GHz.
7. Explain the need for a reference burst in a TDMA system.
8. What is the use of control bits in the data frame ?
9. What is the difference between active and passive satellites ?
10. What does the acronym VSAT stand for ?

PART – B **(5×13=65 Marks)**

11. a) Derive the complete expression for Look Angles, along with intermediate angle in satellite communication. Show that intermediate angle is : **(13)**

$$\alpha = \tan^{-1}\left(\frac{\tan|l_s - l_e|}{\sin(L_e)}\right)$$

(OR)

b) i) A satellite is in a circular orbit around the earth. The altitude of the satellite's orbit above the surface of the earth is 1400 Km.

i) What are the centripetal and centrifugal accelerations acting on the satellite in its orbit ? Give your answer in m/s^2.

ii) What is the velocity of the satellite in this orbit ? Give your answer in km/s.

iii) What is the orbital period of the satellite in this orbit ? Give your answer in hours, minutes and seconds. **(10)**

ii) Differentiate between Geosynchronous and Geostationary orbits. **(3)**

12. a) i) Define and explain the terms roll, pitch and yaw. **(3)**

ii) Describe the tracking, telemetry and command facilities of a satellite communications system. Are these facilities part of the space segment or part of the ground segment of the system ? **(10)**

(OR)

b) i) Explain Spin Stabilization and Three-axis Stabilization. **(5)**

ii) Explain what is meant by thermal control and why this is necessary in a satellite. **(4)**

iii) Explain what is meant by satellite attitude and briefly describe two forms of attitude control. **(4)**

13. a) i) A certain 6/4 GHz satellite uplink has earth station EIRP is 80 dBW; Earth station satellite distance is 35780 Km; attenuation due to atmospheric factors is 2 dB; satellite antennas aperture efficiency is 0.8; satellite antennas aperture area is 0.5 m^2; satellite receivers effective noise temperature is 190 K; satellite receivers bandwidth is 20 MHz. Determine the link margin for satisfactory quality of service if the threshold value of received carrier to noise ratio is 25 dB. **(8)**

ii) A geostationary satellite transmits 5 W of power with an antenna having a gain of 28 dB. The downlink is operated at 4 GHz and the receive antenna is a dish with diameter of 3.6 m. Compute the EIRP transmitted and the power received by the receiving antenna. Assume the receiver antenna efficiency to be 0.7 and all the other losses to be 2 dB. **(5)**

(OR)

b) i) Explain what is meant by saturation flux density. The power received by a 1.8 m parabolic antenna at 14 GHz is 250 pW. Calculate the power flux density (a) in W/m^2 and (b) in dBW/m^2 at the antenna. **(5)**

ii) Explain what is meant by input backoff. An earth station is required to operate at an [EIRP] of 44 dBW in order to produce saturation of the satellite transponder. If the transponder has to be operated in a 10 dB backoff mode, calculate the new value of [EIRP] required. **(5)**

iii) Two amplifiers are connected in cascade, each having a gain of 10 dB and a noise temperature of 200 K. Calculate (a) the overall gain and (b) the effective noise temperature referred to input. **(3)**

14. a) i) Distinguish between preassigned and demand-assigned traffic in relation to a satellite communications network. **(7)**

ii) Given that the IF bandwidth for a 252-channel FM/FDM telephony carrier is 7.52 MHz and that the required [C/N] ratio at the earth station receiver is 13 dB, calculate (a) the [C/T] ratio and (b) the satellite [EIRP] required if the total losses amount to 200 dB and the earth station [G/T] ratio is 37.5 dB/K. **(6)**

(OR)

b) i) Briefly describe the ways in which demand assignment may be carried out in an FDMA network. **(5)**

ii) What is the function of :

a) the burst-code word and

b) the carrier and bit-timing recovery channel in a TDMA burst ? **(4)**

iii) In a TDMA network the reference burst and the Preamble each requires 560 bits, and the nominal guard interval between bursts is equivalent to 120 bits. Given that there are eight traffic bursts and one reference burst per frame and the total frame length is equivalent to 40, 800 bits, calculate the frame efficiency. **(4)**

15. a) i) Explain the characteristics of a typical VSAT system and Key Components for a VSAT network. **(8)**

ii) Compare LEO and MEO satellite. What are the advantage, disadvantage and application of LEO and MEO satellite ? **(5)**

(OR)

b) i) Explain the working of Global Positioning System. **(8)**

ii) Explain the working of Direct Broadcast Satellites in detail. **(5)**

PART – C **(1×15=15 Marks)**

16. a) Consider a (6, 3) linear block code defined by the generator matrix. **(15)**

$$\vec{G} = \begin{bmatrix} 1 & 0 & 0 & 1 & 1 & 0 \\ 0 & 1 & 0 & 0 & 1 & 1 \\ 0 & 0 & 1 & 1 & 0 & 1 \end{bmatrix}$$

1) Find the encoding table for the linear block code.

2) Draw the hardware encoder diagram.

3) Suppose is $\vec{c} = [111000]$ is sent and $\vec{r} = [111001]$ is received. Show how the code can correct this error.

(OR)

b) i) The state of Virginia may be represented roughly as a rectangle bounded by 39.5° N latitude on the north, 36.5° N latitude on the south, 76.0° W longitude on the east and 86.3° W longitude on the west. If a geostationary satellite must be visible throughout virginia at an elevation angle no lower than 20°, what is the range of longitudes within which the sub-satellite point of the satellite must lie ? **(10)**

ii) A ground station lies at latitude = 39.2906 degrees N and longitude = 280.2629 degrees E. A Geostationary satellite at radius r = 42164 km has a longitude of 280.2629 degrees E. Calculate the range and look angles (azimuth and elevation angles) to the satellite. **(5)**

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