| Reg.No.: | | | | | | | | | | | | |
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VIVEKANANDHA COLLEGE OF ENGINEERING FOR WOMEN
[AUTONOMOUS INSTITUTION AFFILIATED TO ANNA UNIVERSITY, CHENNAI]
Elayampalayam – 637 205, Tiruchengode, Namakkal Dt., Tamil Nadu.

**Question Paper Code: 7004**

B.E. / B.Tech. DEGREE END-SEMESTER EXAMINATIONS – MAY / JUNE 2024
Eighth Semester
Electronics and Communication Engineering
U19ECE42 – SATELLITE COMMUNICATION
(Regulation 2019)

Time: Three Hours Maximum: 100 Marks

Answer ALL the questions

| Knowledge Levels (KL) | K1 – Remembering | K3 – Applying | K5 - Evaluating |
|---|---|---|---|
| | K2 – Understanding | K4 – Analyzing | K6 - Creating |

PART – A

(10 x 2 = 20 Marks)

| Q.No. | Questions | Marks | KL | CO |
|---|---|---|---|---|
| 1. | The earth rotates once per sidereal day of 23 h 56 min 4.09 s. Find the radius of the circular orbit. (Consider $\mu$= $3.986004418x10^5$ $km^3/s^2$). | 2 | K3 | CO1 |
| 2. | In an equatorial plane, satellite is revolving with a mean motion of $2x10^{-3}$ $s^{-1}$. Calculate the semi-major axis. | 2 | K3 | CO1 |
| 3. | Outline the functions of Attitude and Orbit Control System (AOCS). | 2 | K2 | CO2 |
| 4. | Define EIRP. | 2 | K1 | CO2 |
| 5. | Mention the limitations of preassigned FDMA. | 2 | K3 | CO3 |
| 6. | What is meant by spectrum spreading? | 2 | K2 | CO3 |
| 7. | Compare MATV and CATV. | 2 | K3 | CO4 |
| 8. | Draw the block diagram of earth station. | 2 | K1 | CO4 |
| 9. | List any - 4 INTELSAT series. | 2 | K1 | CO5 |
| 10. | List any 4 MPEG compression standards. | 2 | K3 | CO5 |

## PART – B

(5 x 13 = 65 Marks)

| Q.No. | | | Questions | Marks | KL | CO |
|---|---|---|---|---|---|---|
| 11. | a) | i. | Define any four terms related to Earth-orbiting Satellites. | 8 | K1 | CO1 |
| | | ii. | Define look angle and also explain look angle determination in detail. | 5 | K2 | CO1 |
| | | | (OR) | | | |
| | b) | i. | Interpret the three Kepler's laws of planetary motion. | 8 | K1 | CO1 |
| | | ii. | Illustrate the orbital parameters used for positioning the satellite. | 5 | K2 | CO1 |
| 12. | a) | i. | The range between a ground station and a satellite is 42,000 km. Determine the free-space loss at the frequencies of 4 GHz and 6 GHz. | 5 | K5 | CO2 |
| | | 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? and Justify. | 8 | K3 | CO2 |
| | | | (OR) | | | |
| | b) | i. | A satellite link operating at 14 GHz has receiver feeder losses of 1.25 dB and a free-space loss of 207 dB. The atmospheric absorption loss is 0.75 dB, and the antenna pointing loss is 0.5 dB. Depolarization losses may be neglected. Determine the total link loss for clear-sky conditions. | 5 | K5 | CO2 |
| | | ii. | From the expression of system noise temperature, prove that C/N ratio is directly proportional to G/T ratio. | 8 | K3 | CO2 |
| 13. | a) | | Compare and contrast Pre-assigned and demand assigned traffic in relation to satellite communication network. | 13 | K4 | CO3 |
| | | | (OR) | | | |
| | b) | | Compare and contrast the salient features of FDMA, TDMA and CDMA multiple access techniques deployed for satellite communication. | 13 | K4 | CO3 |
| 14. | a) | | Interpret the significance of Asynchronous Transfer Mode (ATM) over satellite in satellite link establishment. | 13 | K2 | CO4 |
| | | | (OR) | | | |
| | b) | | Explain the working of satellite television systems with neat block diagram. | 13 | K2 | CO4 |
| 15. | a) | | Explain about orbital spacing, power rating and number of transponders and their capacity. | 13 | K3 | CO5 |

(OR)

| | | | | |
|---|---|---|---|---|
| b) | Describe the operation of VSAT system. Justify the significance of VSAT in widest application. | 13 | K3 | CO5 |

## PART – C

(1 x 15 = 15 Marks)

| Q.No. | | Questions | Marks | KL | CO |
|---|---|---|---|---|---|
| 16. | a) | Tabulate the following scenario for finding the Satellite link Budget. Find CNR.<br>The GEO satellite carries 24 C-band transponders, each with a bandwidth of 36MHz. The downlink band is 3.7–4.2 GHz and satellite uses dual orthogonal circular polarizations and providing an effective RF bandwidth of 864MHz. The satellite provides coverage of the visible earth, which subtends an angle of approximately 17° from a satellite in geostationary orbit, by using a global beam antenna. The on-axis gain of the global beam antenna is approximately 20 dB. Consider an earth station is at the edge of the coverage zone. The calculation of CNR is made at a mid-band frequency of 4 GHz. The saturated output power of the transponder is 80W. Assume an output backoff of 2 dB. The transmitted signal is a single 30MHz bandwidth channel. The maximum path length for a GEO satellite link at the edge of coverage is 40 000 km. Slant path attenuation is 0.2 dB in clear air. Consider 0.5 dB margin for other miscellaneous losses.<br>Intermediately, highlight the results for the following.<br>i. Calculate the antenna physical aperture in wavelength if its aperture efficiency is 65%.<br>ii. Calculate the on-axis EIRP of the transponder.<br>iii. Calculate the path loss. | 15 | K6 | CO2 |
| | | (OR) | | | |
| | b) | Three identical large earth stations with 500W saturated output power transmitters access a 36MHz bandwidth transponder of a GEO satellite using FDMA. The earth stations are all at the same distance from the satellite. The transponder saturated output power is 100W and it is operated with 3 dB output backoff when FDMA is used. The gain of the transponder is 105 dB in its linear range. The bandwidths of the earth station signals are<br>Station A: 15MHz<br>Station B: 10MHz<br>Station C: 5MHz<br>Find the power level at the output of the transponder, and at the input to the transponder, in dBW, for each earth station signal, assuming that the transponder is operating in its linear region with 3 dB output backoff. Each earth station must transmit 250W to achieve an output power of 25W from the transponder. Find the transmit power for each earth station when the transponder is operated with FDMA to make the PSD of each signal equal. | 15 | K6 | CO3 |