Registration No : | | | | | | | | | | |

Total Number of Pages : 02 **B.Tech.**
PEI7J003

7th Semester Regular Examination 2018-19
SATELLITE COMMUNICATION
BRANCH : AEIE, EIE, IEE
Time : 3 Hours
Max Marks : 100
Q.CODE : E044

Answer Question No.1 (Part-1) which is compulsory, any EIGHT from Part-II and any TWO from Part-III.
The figures in the right hand margin indicate marks.

Part- I

Q1 **Short Answer Type Questions (Answer All-10)** **(2 x 10)**

a) Write the conditions required for an orbit to be geo-stationary.
b) Calculate the maximum possible line-of-sight distance between two GEO satellites.
c) Which batteries are preferred for space craft applications? Specify the reason behind it.
d) Why it is not possible to have an elliptical satellite orbit with zero eccentricity?
e) What is the function of transversal equalizer?
f) If in a CDMA system the chip rate is 3.5 Mbps and processing gain is 100, then what would be the message bit rate?
g) What is meant by noise weighting in case of both telephony and TV transmissions?
h) What is the difference between low noise amplifier and low noise block?
i) What is meant by redundant earth station?
j) Why double reflector antennas are often used with large earth stations?

Part- II

Q2 **Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 x 8)**

a) State and explain Kepler's laws of planetary motion with relevance to artificial satellites orbiting the earth.
b) The orbit for an earth-orbiting satellite has an eccentricity of 0.15 and semi-major axis of 10000 km. Assume earth radius equal to 6371 km. Determine (a) its periodic time
(b) the apogee height
(c)the perigee height
c) An earth station is located at Rourkela (22.26° N, 84.85° E) .Determine the earth station's azimuth and elevation angles with respect to a satellite located over Sriharikota (13.73° N, 80.20° E) . The orbital radius is 42164 km. (Assume radius of earth is 6378 km)
d) A 14/11 GHz satellite link has a transponder with an output power level of 20W. The satellite transmit antenna gain at 11 GHz is 30 dB. Path loss to this station is 20 dB , including clear air atmospheric loss. The earth stations used to receive the voice signals with a gain of 40 dB (1m diameter) and a receiver with T_{system} = 150K in clear air, and IF noise bandwidth 50 kHz. Calculate the C/N link margin over a threshold of 6 dB.
e) How does CDMA works? Why this technique is also referred to as spread spectrum technique? What are the advantages associated with spread spectrum communication?
f) A certain TDMA transmission has a frame efficiency of about 97.5%. If the TDMA frame length and burst bit rate are 15 ms and 80 Mbps respectively, determine the number of overhead bits that do not carry any traffic information.
g) Write the operational principle of a frequency division multiple access (FDMA) system. What is the significance of guard band. Distinguish between bandwidth-limited and power-limited operation as applied to an FDMA network.
h) Explain what is meant by coherent detection. Give an example of non-coherent detector .Can such detector be used for BPSK? Justify your answer
i) A satellite TV link is designed to provide a video signal-to-noise ratio of 60 dB. The highest video base band frequency is 4.2 MHz and the peak deviation is 9.4 MHz. Determine the carrier-to-noise ratio required at the input to the FM detector, given that the combined noise weighting ,emphasis improvement and implementation margin is 12 dB

j) Explain the transmit-receive earth station using suitable block diagram.

k) With suitable block diagram discuss the simplified double conversion transponder for 14/11 GHz band.

l) Discuss the different satellite tracking techniques based on generation of angular errors.

Part-III

Long Answer Type Questions (Answer Any Two out of Four)

Q3 Describe the complete uplink and downlink system design for Ku band satellite system considering any suitable case. **(16)**

Q4 Two earth stationsare located at Rourkela (22.26° N, 84.85° E) and Puri(19.81° N, 85.83° E).They are communicating with each other via a satellite located over Sriharikota (13.73° N, 80.20° E).Calculate the total delay in sending 500 kbs of information if the transmission speed is 10 Mbps. Assume the orbital radius to be 42164 km and radius of earth is 6378 km **(16)**

Q5 A satellite communication system uses a single 60 MHz bandwidth Ku-band transponder to carry 300 two-way telephone conversations using analog modulation with SCPC-FM. The parameters of any one channel are, voice channel bandwidth: 100 - 3400 Hz, RF channel bandwidth: 45 kHz, RF channel spacing: 65 kHz, downlink path loss (incl. atmos. loss):206.5 dB, satellite downlink antenna gain (on axis): 29 dB, demodulator FM threshold: 5 dB. The transponder has a saturated power output of 40 watts, but is run with 3 dB output backoff to achieve near-linear operation. The uplink stations which transmit the SCPC-FM signals to the transponder achieve $(C/N)_{up}$= 25 dB in the 45 kHz channel noise bandwidth of the earth station receiver. The system noise temperature of the receiving earth station is 110 K in clear air. **(16)**

a) Calculate the power per RF channel at the transponder output.

b) Calculate the gain of the antenna at a receiving earth station that is located on the -3dB contour of the satellite foot print which will provide an overall C/N = 10 dB in a receiver for single RF channel with a noise bandwidth of 45 kHz, in clear air conditions.

c) The receiver applies a de-emphasis weighting of 6 dB to recover the voice signal and a psophometric weighting of 2.5 dB. Calculate the weighted S/N at the base b and output of the receiver.

d) Is the S/N adequate in clear air? If the downlink fades by 4 dB because of the rain, what is the S/N at the baseband? Is this acceptable for voice communication?

Q6 The western education belt of Odisha can be represented approximately on a map as an area bounded by 21.46° N latitude, 22.26° Nlatitude, 83.98° E longitude, and 84.85° Elongitude. A geostationary satellite located at 84.28° E longitude has an antenna with a spot beam that covers all of the area at a downlink center frequency of 11.55 MHz. So estimate the antennadimensions' subject to two different assumptions. In both cases use an aperture efficiency of 65 percent. **(16)**

a) The antenna is a circular parabolic reflector generating a circular beam with a 3 dBbeamwidth equal to the diagonal of the area bounding the western education belt of Odisha. Calculate the beamwidth of the antenna from simple geometry. Hence determine the diameter of the antenna on the satellitein meters and its approximate gain in decibels.

b) The antenna is an elliptical parabolic reflector with 3 dB beamwidths in the N-S and E-Wdirections are equal to the height and the width of the area boundingwestern education belt of Odisha. Calculate the required3 dB beamwidths of the satellite antenna. Calculate the approximate gain of the antenna.