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

Total Number of Pages : 03 **B.Tech.**
PET7J002

7th Semester Regular Examination 2018-19
SATELLITE COMMUNICATION SYSTEMS
BRANCH : ECE, ETC
Time : 3 Hours
Max Marks: 100
Q.CODE : E050

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) Why does the period of a satellite in an equatorial synchronous orbit deviate a small amount from 24 hours? What technique is adopted to correct the period?

b) What is understood by look angle in satellite communication systems? What parameters must be known to calculate the look angle of a geosynchronous satellite?

c) Why is it preferable to operate with a satellite positioned west, rather than east, of earth station longitude?

d) What are the significances of energy dispersal waveform in television signal?

e) Three message signals with respective bandwidths of 2.5 kHz, 3.6kHz and 4.2 kHz are to be transmitted over a common channel in a time multiplexed manner. Determine the sampling interval of the composite signal.

f) What is the difference between cross polarization discrimination and polarization isolation?

g) What is meant by effective path length in connection with rain attenuation?

h) Why is Faraday rotation of no concern with circularly polarized waves?

i) Why is it desirable to down convert the satellite TV signal received at the antenna?

j) What is the effective aperture of an isotropic antenna operating at a wavelength of 1 cm?

Part- II

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

a) Derive an expression for a digital satellite link and explain how it is dependent on system bandwidth?

b) An earth station is located at Puri(19.8134° N, 85.8315° 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 6378km)

c) 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 7 dB.

d) The typical minimum elevation angles used by earth stations operating in the commercial Fixed Services using Satellites (FSS) communications bands are as follows: C-Band 5°; Ku-Band 10°; and Ka-Band 20°
Determine the maximum and minimum range in kilometers from an earth station to a geostationary satellite in the three bands.
To what round-trip signal propagation times do these ranges correspond?

e) How do you define TDMA frame efficiency? Why do we need to have a high TDMA frame efficiency? What are the various possible approaches to increase TDMA frame efficiency?

f) A geostationary satellite has a round trip delay variation of 50 ns per second due to station keeping errors. If the time synchronization of DS-CDMA signals from different earth stations is not exceed 15% of the chip duration, determine the maximum allowable chip rate so that a station can make a correction once per satellite round trip delay. Assume satellite round trip delay to be 300 ms.

g) Explain in detail the operation of Spade system of demand assignment. What is the function of the common signaling channel?

h) Explain what is meant by pre-emphasis and de-emphasis. Why these are effective in improving signal-to-noise ratio in FM transmission. State typical improvement levels expected for both telephony and TV transmissions

i) Explain how a QPSK signal can be represented by BPSK signal. Draw the constellation diagram for QPSK signal. Derive the relationship between the bandwidth of QPSK signal with that of BPSK signal.

j) A transmission path between an earth station and a satellite has an angle of elevation of 28° with reference to the earth. The transmission is circularly polarized at a frequency of 12 GHz. Given that rain attenuation on the path is 1 dB, calculate the cross polarization discrimination.

k) Briefly describe the following tests performed during earth station installation and commissioning:

a) Receiver figure of merit
b) EIRP stability
c) Spectral shape
d) Transmit cross-polarization isolation

l) With neat block diagram explain the TTC&M System.

Part-III

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

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

Q4 Two earth station are located at Chandipur(21.43° N, 87.01° E) and Sunabeda (18.72° N, 82.83° 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 50 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 back off to achieve near-linear operation. The uplink stations which transmit the SCPC-FM signals to the transponder achieve $(C/N)_{up}$= 25 dB inthe 45 kHz channel noise bandwidth of the earth station receiver. The system noise temperature of the receiving earth station is 120 K in clear air. **(16)**

a) Calculate the power per RF channel at the transponder output.
b) Calculate the diameter of the receiving antenna with a circular aperture having 55% aperture efficiency at a frequency of 12 GHz.
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 band output of the receiver.
d) Is the S/N adequate in clear air? If the downlink fades by 5 dB because of the rain, what is the S/N at the baseband? Is this acceptable for voice communication?

Q6 The eastern belt of Odisha can be represented approximately on a map as an area bounded by 19.31° Nlatitude, 21.34° Nlatitude, 84.79° Elongitude, and 86.66° E longitude. A geostationary satellite located at 85.48° E longitude has an antenna with a spot beam that covers all of the area at a downlink center frequency of 12.54MHz. So estimate the antenna dimensions' subject to two different assumptions. In both cases use an aperture efficiency of 65 percent. **(16)**

The antenna is a circular parabolic reflector generating a circular beam with a 3 dB beam width equal to the diagonal of the area bounding the eastern belt of Odisha.

a) Calculate the beam width of the antenna from simple geometry. Hence determine the diameter of the antenna on the satellite in meters and its approximate gain in decibels.

b) The antenna is an elliptical parabolic reflector with 3 dB beam widths in the N-S and E-W directions are equal to the height and the width of the area bounding eastern belt of Odisha. Calculate the required 3 dB beam widths of the satellite antenna. Calculate the approximate gain of the antenna.