Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/M.TECH(ECE-COMM)/SEM-2/MCE-205-A/2012

2012
SATELLITE COMMUNICATION

Time Allotted : 3 Hours *Full Marks* : 70

The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

Answer Question no. 1 is compulsorily and any *four* from the rest.

1. Answer the following questions : $7 \times 2 = 14$

   a) State Kepler's third law of motion.

   b) Why is the uplink and downlink frequencies kept different ?

   c) What is polarization-loss of an antenna and how is it measured ?

   d) Define the equatorial orbit of a satellite.

   e) What is the function of Altitude and Orbit Control subsystem ?

   f) Write down two important applications of geostationary satellites.

   g) What is 'TPE' ?

2 a) Why should a geostationary satellite be at an altitude of 35786 km above the Earth's surface ?

b) Briefly describe the important characteristics and the preferred uses of the following orbits :

Molniya orbit, LEO orbit and MEO orbit.

c) The apogee and perigee distances of a satellite orbiting in an elliptical orbit are, respectively, 45000 km. and 7000km. Determine

i) the semi-major axis of the elliptical orbit

ii) the orbit eccentricity

iii) the distance between the centre of the earth and the centre of the elliptical orbit. 2 + (3 + 3 + 3) + 3

3. a) Compute the line-of-sight distance between the two satellites placed in the same circular orbit. When this distance will become maximum ? Also calculate it.

b) What is meant by orbital perturbation and which factors are responsible for that ? What is anomalistic period ?

c) Name two major LEO satellite systems offering mobile satellite services. (2 + 1 + 3) + (2 + 2 +2) + 2

4. a) Derive Fris Transmission equation.

b) A geostationary satellite at a distance of 36000 km from the surface of the Earth radiates a power of 10W in the desired direction through an antenna having a gain of 20 dB. What would be the power density at a receiving site on the surface of Earth and also the power received by an antenna having an effective aperture of 10 m^2 ?

c) What do you mean by Earth Design optimization ?

d) What are the advantages and disadvantages of TDMA over FDMA ? 4 + 3 + 3 + 4

5. a) Briefly describe the terms 'noise-figure' and 'noise-temperarure'. How do the noise-figure and noise-temperarure specifications of cascaded arrangement of more than one stage depend upon noise-figure, noise-temperarure and the gains of individual stages ? Derive relevant expressions.

b) A 12 GHz receiver consists of an RF stage with gain G_1 = 30 dB and noise-temperature T_1 = 20 K, a down converter with gain G_2 = 10 dB and noise-temperature T_2 = 360 K and an IF amplifier stage with gain G_3 = 15 dB and noise-temperature T_3 = 1000 K. Compute the noise-figure specifications of the three stages and then compute the overall noise-figure from the individual noise-figure specifications. Take reference temperature to be 290 K. (2 + 2 + 5) + 5

6. a) What do you mean by the link-budget of a satellite communication link ? What type of information do you get from such an analysis ?

b) Write down the power-balance equation describing the link-budget for both uplink and downlink.

c) Calculate the free-space path loss in decibels for the following conditions :

Given that Earth Station transmitting antenna EIRP = 45 dB, satellite receiving antenna gain = 15 dB and

received power at satellite = - 140dB. (3 + 3) + 4 + 4

7. a) What is satellite transponder ?

b) Name the different types of transponders depending on processing the signal. Describe briefly the working principle of any one of them.

c) Determine the power-gain and 3dB beam-width of a reflector antenna having an aperture area of $20m^2$ at an operating frequency of 10GHz. 3 + (2 + 5) + 4