| Name : | (4) |
|--------------------------|-----|
| Roll No.: | |
| Inviailator'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:

 $7 \times 2 = 14$

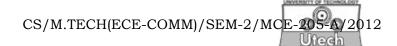
- a) State Kepler's third law of motion.
- b) Why is the uplink and downlink frequencies kept different?
- c) What is polarization-loss of an antenna and how is it measured?
- d) Define the equatorial orbit of a satellite.
- e) What is the function of Altitude and Orbit Control subsystem?
- f) Write down two important applications of geostationary satellites.
- g) What is 'TPE'?

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- 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 m²?



- 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.

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- 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

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