

Seat No.: \_\_\_\_\_

Enrolment No. \_\_\_\_\_

**GUJARAT TECHNOLOGICAL UNIVERSITY**  
**BE - SEMESTER-VII EXAMINATION – WINTER 2015**

**Subject Code: 171007**

**Date: 04/12/2015**

**Subject Name: Satellite Communication**

**Time: 10:30am to 1:00pm**

**Total Marks: 70**

**Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1 (a)** State Kepler's three laws of planetary motion. Quote Kepler's constant. A satellite in an elliptical orbit around the earth has an apogee of 39,152 km and a perigee of 500 km. What is the orbital period of the satellite? Average earth radius is 6,378.137 km. **07**
- (b)** What kind of forces causes the state of "Free Fall" of a satellite body so that it can continue being in motion once it is placed in the orbit? Explain in details. **07**
- Q.2 (a)** State any three reasons that cause Orbital Perturbations. Identify locations called Satellite graveyards in the orbit. Explain the response of the satellite at such locations. **07**
- (b)** Using a neat sketch, show and explain **07**
- (1) Inclination angle
  - (2) Eccentricity
  - (3) Perigee
  - (4) Apogee
  - (5) Foci of an ellipse
  - (6) Semi major axis and
  - (7) Sub satellite point
- OR**
- (b)** Write a short note on TTC&M. **07**
- Q.3 (a)** Define Downlink. Draw a pictorial representation of a Downlink. Show the power budget calculations for a downlink path. **07**
- (b)** What is the significance of Geosynchronous Transfer Orbit for correct orientation of the satellite? How can we position a satellite to higher altitudes from the LEO height with the help of GTOs? Explain any one method. **07**
- OR**
- Q.3 (a)** What parameters apart from rain affect the satellite system? Explain. **07**
- (b)** Write a short note on the solar eclipse of satellite and sun transit outage. **07**

- Q.4 (a)** What kinds of batteries are used to meet the power needs of a satellite? A direct broadcast TV satellite requires 500 W of electrical power to operate the housekeeping functions of the satellite and 5 kW to operate its 16 high power transponders. The longest duration of an eclipse is 70 minutes, during which time the batteries must provide power to keep the satellite operating, but the batteries must not discharge below 70% of their capacity. The satellite bus operates at 48 volts. What is the current that must be supplied by the power conditioning unit to keep the satellite operating normally? Battery capacity is rated in Ampere hours; the product of the current (in amps) that the battery can supply multiplied by the length of time that this current can be supplied before the battery is fully discharged. The satellite batteries must not discharge beyond 70% of their rated capacity during eclipse. Find the battery capacity required for this DBS-TV satellite. If batteries weigh 1.25 kg per Ampere-hour of capacity, how much weight on this satellite is devoted to batteries? If half of the transponders are shut down during eclipse, what saving in battery weight is achieved? **07**
- (b)** Define Elevation and Azimuthal angles of a satellite. Look angles for the Earth station is at latitude  $52^{\circ}\text{N}$  and  $0^{\circ}$  E longitude at London, England, Dockyard region. The look angle for the satellite is at latitude  $0^{\circ}\text{N}$  and  $66^{\circ}$  E longitude at Geostationary INTELSAT, IOR primary. Find the central angle, the elevation angle, the intermediate angle and the azimuthal angle. **07**

**OR**

- Q.4 (a)** A geostationary satellite carries a C-band transponder which transmits 15 watts into an antenna with an on-axis gain of 32 dB. An earth station is in the center of the antenna beam from the satellite, at a distance of 38,500 km. For a frequency of 4.2 GHz, calculate the incident flux density at the earth station in watts per square meter and in  $\text{dB W/m}^2$ . The earth station has an antenna with a circular aperture 3 m in diameter and an aperture efficiency of 62%. Calculate the received power level in watts and in dB W at the antenna output port. Calculate the on-axis gain of the antenna in decibels. Calculate the free space path loss between the satellite and the earth station. Calculate the power received,  $P_r$ , at the earth station. **07**
- (b)** The telemetry system of a geostationary communications satellite samples 100 sensors on the spacecraft in sequence. Each sample is transmitted to earth as an eight-bit word in a TDM frame. An additional 200 bits are added to the frame for synchronization and status information. The data are then transmitted at a rate of 1 kilobit per second using BPSK modulation of a low-power carrier. How long does it take to send a complete set of samples to earth from the satellite? Including the propagation delay, what is the longest time the earth station operator must wait for a change in a parameter occurring at the spacecraft to reflect the new value of that parameter being received via the telemetry link? Evaluate the same for a QPSK modulated carrier; **07**

- Q.5 (a)** Write a short note on VSAT. **07**
- (b)** Explain the working of the GPS system. **07**

**OR**

- Q.5 (a)** Write a short note on Equipment Reliability and Space Qualification. **07**
- (b)** How is error control achieved in a Digital DBS TV? **07**

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