



**MAULANA ABUL KALAM AZAD UNIVERSITY OF
TECHNOLOGY, WEST BENGAL**

Paper Code : EC-801C

SATELLITE COMMUNICATION & REMOTE SENSING

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. <http://www.makaut.com>*

Group – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for the followings (any ten): 1×10=10
- (i) A satellite in geostationary orbit may be described as a satellite approximately _____ km above the equator and whose orbit takes 24 hours.
- (a) 30,000 (b) 22,300
(c) 36,000 (d) 40,000
- (ii) INTELSAT stands for
- (a) International Telecommunications Satellite (b) Indian Telecommunications Satellite
(c) Inter Telecommunications Satellite (d) None of these
- (iii) The refractive index of the ocean water
- (a) increases with salinity. (b) increases with temperature.
(c) decreases with salinity. (d) decreases with temperature.
- (iv) The arrangement of terrain features which provides attributes : the shape, size and texture of objects, is called <http://www.makaut.com>
- (a) spectral variation (b) spatial variation
(c) temporal variation (d) none of these
- (v) The instruments which provide electromagnetic radiation of specified wavelength or a band of wavelengths to illuminate the earth surface, are called
- (a) sensors (b) passive sensors
(c) active sensors (d) none of these

Turn Over

- (vi) The basic requirement of any sensor system, is
 (a) radiometric resolution (b) spatial and spectral resolution
 (c) temporal resolution (d) all of these
- (vii) The reflectance from a surface is called specular reflection if it follows
 (a) Snell's law (b) Lambert's cosine law
 (c) Planck's law (d) All of these
- (viii) For an elliptical orbit
 (a) $e = 0$ (b) $1 < e < 0$
 (c) $e = 1$ (d) None of the above
- (ix) Apogee is defined as
 (a) the point farthest from earth. (b) the point nearest from earth.
 (c) the point smallest from earth. (d) none of the above.
- (x) Which one is a Transfer orbit.
 (a) LEO (b) Hohman
 (c) MEO (d) HAP
- (xi) The down link frequency in the C band transponder is
 (a) 6 GHz (b) 4 GHz
 (c) 14 GHz (d) 11 GHz
- (xii) The carrier to noise ratio for a satellite depends upon
 (a) Effective Isotropic Radiated power (b) Bandwidth
 (c) Free space path losses (d) All of them
- (xiii) The signal from a satellite is normally aimed at a specific area called the _____.
 (a) path (b) effect
 (c) footprint (d) none of the above
- (xiv) The multiple access technique used for digital transmission is
 (a) TDMA (b) FDMA
 (c) Both (a) and (b) (d) None of them

Group – B

(Short Answer Type Questions)

Answer any three of the following.

5×3=15

2. State Kepler's three laws of planetary motion.

5

3. (a) What do you mean by Sidereal day?

2

(b) Explain the orbital parameters to determine the satellite orbit.

3

4. Prove that the path of a satellite around the earth is an ellipse and best described by :

$$r = \frac{p}{1 + e \cos(\theta - \theta_0)}$$

where, $p = \frac{h^2}{\mu}$ and $e = \frac{h^2}{\mu} C$, they have their usual meanings.

5. Prove that the expression of velocity of a satellite is expressed as :

$v^2 = \mu \left(\frac{2}{r} - \frac{1}{a} \right)$, where, r = radial distance a = semi-major axis and also find the values of perigee

(ϑ_p) apogee (ϑ_a)

3+2=5

6. Describe Hohmann Orbital Transfer for a satellite and derive total velocity increment $(\vartheta_H = \Delta\vartheta_1 + \Delta\vartheta_2)$ in terms of standard parameters and also with neat diagram.

3+2=5

7. (a) What do you mean by Powered Flight?

(b) With necessary schematic diagram derive the Rocket equation.

2+3=5

Group – C

(Long Answer Type Questions)

Answer any three of the following.

15×3=45

8. (a) What do you mean by Two Body problem in Orbital mechanics ? Use necessary diagram. 5
 (b) Derive the expression of mean anomaly (M) as known as Kepler's Equation described below : 5
 $M = E - e \sin E$, where, E = eccentric anomaly and e = eccentricity.
 (c) Prove that required change in velocity due to change in longitude is given by : 5

$$(\Delta v)_{\text{total}} = \frac{2}{3} r \dot{\lambda}, \text{ where } \dot{\lambda} = \text{drift rate and } r = \text{radial distance}$$

9. (a) Using Friis Transmission equation derive that Free space Loss (L_{FS}) is given by 5
 $L_{FS} = 22 + 20 \log_{10} \left(\frac{d}{\lambda} \right) \text{ dB}$ for, general satellite communication link.
 (b) What do you mean by Noise Power? 2
 (c) Prove that, Carrier to Noise Ratio (C/N) for a satellite communication is expressed as :

$$\frac{C}{N} = \frac{P_T G_T G_R \left(\frac{\lambda}{4\pi d} \right)^2}{K T_S B L_A}, \text{ using standard parameters.}$$

- (d) What do you mean by Geostationary Orbit? 3
 10. (a) Derive the complete link design for satellite communication given as follows : 5
 $(C/N_0)_T^{-1} = (C/N_0)_U^{-1} + (C/N_0)_B^{-1}$
 (b) For an earth station having an antenna of diameter 30 m and overall efficiency of 68%, the working signal frequency is 4150 MHz. At this frequency the system noise temperature is 79K when the antenna points at the satellite at an elevation angle of 28°. Calculate G/T ratio of the earth station. In case the sky noise temperature rises to 88 K, what would be the new G/T ratio?
 (c) Describe the Telemetry, Tracking and Command facility of a Satellite Communication System. 5

11. (a) What is attitude control system? How it performs its operation? 5
(b) Draw the block diagram of a Transponder and explain its stages. 5
(c) What are different multiple access scheme used in satellite communication? Make a comparative study. 5
12. (a) Define sub-satellite point. 2
(b) A satellite is in an elliptical orbit with a perigee of 1000 km and apogee 4000 km. Using mean earth radius of 6378.14 km, find the orbital period in hours. 5
(c) What is Orbital perturbation? Explain briefly. 3
(d) A satellite at a distance of 36,000 km from the surface of the earth radiates a power of 5W, from an antenna of gain 16dB. Find the flux density and power received by an antenna of effective area 14 sq.m. If the receiving antenna has a gain of 60dB, calculate the received power.
13. (a) Describe how sea surface temperature can be measured in remote sensing? 4
(b) Explain how TRMM Microwave Imager (TMI) works to provide rainfall information? 5
(c) Explain the spectral and radiometric resolution. 4
(d) Distinguish between active and passive remote sensing. 2
14. Write short notes on any three: 3×5=15
(a) Radio Ocultation
(b) Radiometer
(c) Code Division Multiple Access
(d) GPS system
(e) RADAR Imaging
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