LNMIIT
The LNM Institute of Information Technology

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Department: Electronics and Communication Engineering

Antenna Engineering (ECE3071)

Exam Type: Mid Term

[14 Dec 05 1]

Time: 90 minutes **Date: February 25, 2020** **Max. Marks: 30**

Instructions:

1. ***The Question Paper has TWO PAGES.***
2. ***All the questions are compulsory and are worth 5 marks each.***

1. Q.1 Assuming **exp(+jωt)** type of time-dependence in all fields, potentials, and sources, prove the following relationships (various symbols have meanings well-known to you).

i) $E=[1/(j\omega\varepsilon\mu)][\nabla\nabla.A]-j\omega A$

ii) $E=[1/(j\omega\varepsilon\mu)][\nabla x\nabla xA-\mu J]$

Q.2 Starting with the well-known mathematical expressions for the near-field components of a Hertzian dipole antenna, show that the Poynting vector has (in both near- and far-field regions) only a radial component. Also derive the mathematical formula for the radiation resistance of this antenna. Clearly state the various assumptions made.

Q. 3 Starting with the basic definition of the magnetic vector potential **A** and the four Maxwell's equations, and assuming suitably-sinusoidal current distributions in the top-half and bottom-half sections of a z-directed center-fed dipole antenna of an arbitrary length L = 2H, derive the mathematical expressions for the far-field components radiated by this antenna.

Q. 4 For a 10cm long dipole antenna carrying a current of exp(j10000000000t) Amperes (t represents time in seconds and j represents the square-root of -1) situated at the origin of the coordinate system, calculate the magnitudes of all radiated field components in a plane at 45-degree angle to the length of the antenna at a distance of 1 cm from the antenna. How much power is the antenna radiating?

Q. 5 Calculate the directivity, the effective aperture, the radiation resistance, and the effective length of a 10-m long center-fed dipole antenna operating at 15 MHz frequency.

Q. 6 For the SATCOM link shown in FIGURE 6, calculate the various power levels (S1, S2, S3, and S4). Assume that the satellite is in a geostationary orbit, that the up-link frequency is 6 GHz, and that the down-link frequency is 4000 MHz.

$\eta = 0.6$.

SATCOM LINK

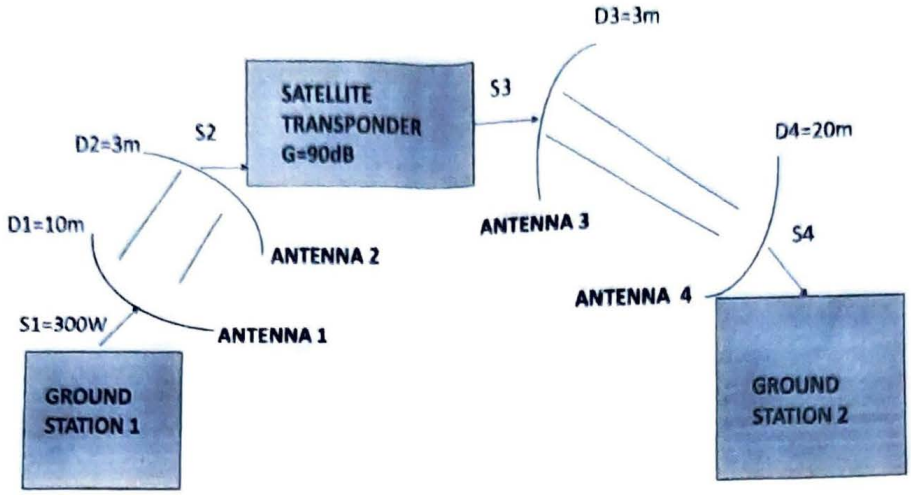

FIGURE 6