Seat No.	

T.E. (E&TC) (Semester - V) Examination, May - 2017

ANTENNA & WAVE PROPAGATION

Sub. Code : 66314

Day and Date : Monday, 15 - 05 - 2017 **Total Marks : 100**

Time : 10.00 a.m. to 01.00 p.m.

Instructions : 1) All questions are compulsory.

2) Figure to the right indicate full marks.

3) Use of non-programmable calculator is allowed.

4) Assume suitable data if necessary.

SECTION - I

Q1) Attempt any Two : [16]

a) The power radiated by a lossless antenna is 10W. The directional characteristics of the antenna are represented by the radiation intensity of

$$\left.\begin{aligned} U &= BO\cos^2\theta \\ U &= BO\cos^3\theta \end{aligned}\right\} \text{(Watts/unit solid angle)} \quad \left(0 \le \theta \le \frac{\pi}{2}, 0 \le \varphi \le 2\pi\right)$$

For each find the :

i) Maximum power density (in watts/square meter) at a distance of 1,000m (assume far-field distance)

ii) Exact directivity in db of the antenna.

b) With polar coordinates & power pattern, explain beam solid angle (in Sr & sq.degree) of the antenna.

c) Obtain the equations of null directions (ϕ_0) for both broadside & end-five arrays of n-isotropic point sources of equal amplitude & spacing.

Q2) Attempt any Two : [16]

a) A plane wave is incident on short dipole antenna & wave is linearly polarized with electric field inY-direction. It's terminal resistance is equal to radiation resistance & loss resistance is zero. Find the :

i) Maximum effective aperture of dipole

ii) Directivity of dipole.

b) Obtain the equations of electric field of two isotropic sources by considering :

i) Same amplitude & opposite phase.

ii) Same amplitude & in-phase quadrature.

Determine ϕ_{max} and draw radiation pattern of array for each case.

c) Draw and explain infinite & finite biconical antennas.

Q3) Attempt any Two : [18]

a) Give experimental set up & measurement procedure of beamwidth & directivity measurement of antenna.

b) A communication satellite is in a stationary orbit about the earth (assume altitude of 22,300 status miles). It's transmitter generates 8.0W. Assume the transmitting antenna is isotropic. It's signal is received by the 210 ft diameter tracking paraboloidal antenna on the earth at the NASA tracking station. At a frequency of 2 GHz, determine :

i) the power density (in W/m^2) incident on the receiving antenna.

ii) the power received by the ground based antenna whose gain is 60 dB.

c) Design a rectangular microstrip antenna using a substrate (RT/duroid 5880) with dielectric constant of 2.2, h = 0.0625 inch (0.1588 cm) so as to resonate at 10 GHz. Determine effective length of patch.

SECTION - II

Q4) Attempt any Two :

a) With the help of geometry of direct & ground reflected waves, obtain the equation for reflection factor for horizontal & vertical polarization. [8]

b) For ionosphere, define & obtain equations of [8]

i) Refractive index

ii) Plasma frequency

iii) Critical frequency &

iv) Phase & group velocities

c) A low power, short range radar is solid-state throught, including a low noise RF amplifier which gives it an overall noise figure of 5.77 dB. If the antenna diameter is 1m, the IF bandwidth is 500 KHz, the operating frequency is a GHz and radar set is supposed to be capable of detecting targets of $5m^2$ cross sectional area at a maximum distance of 12 km, what must be the peak transmitted pulse power? [8]

Q5) Attempt any Two :

a) A transmitter operating at a frequency of 1.5 MHz is required to provide a ground wave field strength of 0.5 MV/M at a distance of 10 km. A short vertical transmitting antenna has an efficiency of 50%. The conductivity of ground is 5×10^{-5} (Mho)/cm and its relative permittivity is 10. Find the transmitter power required. [8]

b) Derive relation between rotation of plane of polarization and electron density. [8]

c) What are RADAR becons, explain? State applications of RADAR becon and derive equation for becon range. [8]

Q6) Attempt any Two :

a) Calculate maximum range of radar system which operates at 3 cm with peak pulse power of 500 kW, if its minimum receivable power is 10^{-13}W, the capture area of its antenna is $5m^2$, and the radar cross sectional area of target is $20m^2$. [9]

b) With the help of perpendicular propagation and parallel propagation explain wave propagation in ionosphere. [9]

c) For elevated dipole antenna above plane earth derive expression for Ez & $E\phi$. [9]

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