1st midterm exam ANTENNAS AND PROPAGATION - 18.10.2016

1. If we see suspicious signals on a spectrum analyzer, that may not really exist, but are just a nonlinear product inside the spectrum analyzer, the countermeasure is:

(A) narrow the resolution | (B) increase the sweep time | (C) increase the input attenuation | (D) narrow the video filter

2. The 3D spherical coordinate system (r,θ,Φ) is right-handed with the north pole in the direction of the Cartesian axis z. Converting the spherical coordinates (r,θ,Φ) into Cartesian coordinates (x,y,z) the Cartesian coordinate x is obtained as:

(A) $r.\sin\theta.\sin\Phi$ | (B) $r.\sin\theta.\cos\Phi$ | (C) $r.\cos\theta.\sin\Phi$ | (D) $r.\cos\theta.\cos\Phi$

3. A hollow metal pipe of circular cross-section is used as a waveguide on its fundamental mode. The forward wave has the following electric field $\bar{E}$ components:

(A) only transversal $\bar{E}$ | (B) only longitudinal $\bar{E}$ | (C) both transversal and longitudinal $\bar{E}$ | (D) does not have any $\bar{E}$

4. The vector potential $\bar{A}$ is computed from the current density $\bar{J}$ by solving the vector wave equation $\Delta\bar{A}+\omega^2\mu\epsilon\bar{A}=-\mu\bar{J}$. The wave equation for the vector potential (as written here) works with the following units (MKSA):

(A) Vs | (B) Vs/m | (C) Vs/m^2 | (D) Vs/m^3

5. The largest radio-telescope on the world was built in China with the diameter of the primary mirror equal to d=500m. At what distance r=? starts its far field while operating at the hydrogen-line frequency of 1.42GHz? ($c_0\approx3\cdot10^8$m/s)

(A) 4733m | (B) 211km | (C) 2367km | (D) 11200km

6. A switching power supply includes a transformer causing radio interference at a frequency of f=50kHz. At what distance r=? are its electric field $\bar{E}$ and magnetic field $\bar{H}$ approximately in the ratio of the free-space wave impedance $Z_0\approx377\Omega$? ($c_0\approx3\cdot10^8$m/s)

(A) 9.55cm | (B) 9.55m | (C) 95.5m | (D) 955m

7. The radiation pattern of a ground-plane antenna at f=180MHz is being spoiled by unwanted currents in the supporting mast. The length l=? of the radials (rods forming the skirt of the antenna) is chosen for the lowest mast current: ($c_0\approx3\cdot10^8$m/s)

(A) 0.4m | (B) 0.5m | (C) 0.6m | (D) 0.7m

8. A street light contains a P=250W bulb with an efficiency of η=30% on a h=7m high pole above ground. What is power-flux density of light $|\bar{S}|$=? on the ground at a horizontal distance x=5m from the pole? The atmospheric attenuation can be neglected.

(A) $81mW/m^2$ | (B) $364mW/m^2$ | (C) $3.64W/m^2$ | (D) $81W/m^2$

9. GPS navigation satellites are circling the Earth at an altitude of h=20200km above the surface. What directivity D=? is required for the on-board antenna to cover the whole visible hemisphere? The Earth is assumed a sphere with a diameter of R=6378km.

(A) 12.4dBi | (B) 15.4dBi | (C) 18.4dBi | (D) 24.4dBi

10. The gain G is measured in a free-space link between two identical unknown antennas at a distance of r=3m. What is the expected uncertainty ΔG [dBi] of the measurement due to the uncertainty of each antenna phase center amounting to Δr=+/-10cm?

(A) +/-0.1dBi | (B) +/-0.6dBi | (C) +/-1.5dBi | (D) +/-4dBi

11. A weather satellite is transmitting on f=137.5MHz with a power of P_{TX}=5W to an omnidirectional antenna G_{TX}=1. What is the maximum radio range r=? to a ground station with an omnidirectional antenna G_{RX}=1 and receiver sensitivity P_{RX}=-110dBm? ($c_0\approx3\cdot10^8$m/s)

(A) 487km | (B) 974km | (C) 1948km | (D) 3897km

12. A fluorescent light bulb is causing interference to a medium-wave receiver (λ=300m) with its electric field $\bar{E}_i$. The best countermeasure against this interference is:

(A) a ferrite receiving antenna | (B) an electrical whip antenna | (C) reorienting the receiving antenna | (D) there is no countermeasure

Name: Email: