

## 79152 Antennas and Radio Communications

Examination date: May 9, 2001

### Examination problems

1. The effective aperture of a 1.22-m-diameter parabolic reflector antenna is 55 percent of the physical aperture area. Compute the antenna gain in dB at 20 GHz.
2. Show that the array factor of a uniformly excited, equally spaced linear array reduces to the array pattern of a line current source in the limit of a small spacing between the elements.
3. Explain the principles of the design of broadband antennas. Is it possible to realize a very broadband antenna with a very high gain? Explain your answer.
4. A helix antenna has five turns and its circumference is one wavelength. Sketch the field pattern.
5. A small (in wavelength) square (side  $a$ ) loop antenna is loaded by a bulk impedance connected in the centre of one of the sides of the square. The antenna is illuminated by a plane electromagnetic wave whose electric field  $\mathbf{E}$  is parallel to the antenna plane. Find the electromotive force at the antenna load. Explain your approximations. How the result depends on the propagation direction of the incident wave?

You can use any materials you might find helpful. The following materials are recommended: Warren L. Stutzman, Gary A. Thiele: *Antenna theory and design* (John Wiley & Sons, Second edition, 1998); K. Nikoskinen, *Sähkömagnetiikan kaavoja*, Otatieto (883), 1992; S.A. Tretyakov: *Waveguide and antenna theory*, TKK, Sähkömagnetiikan laboratorion oppimateriaalisarja, no. 17, 1999 (or the reprint available from the Laboratory secretary).