Radio Astronomy and Interferometry 2015
Demonstrations, Set 3

15. Suppose a source has a temperature T = 600 K and angular size θ = 40 arc sec. The source is observed with a radio telescope that has HPBW = 8 arc min. Calculate the antenna temperature T_A when the telescope is pointed to the source.

16. An outburst of an H_2O maser (at 22.235 GHz) in the Orion region (distance from the Sun 500 pc) gave a peak flux density of 10^6 Jy over a 1 MHz band. If this maser radiation were measured with a 100 m telescope, which has a collecting area of 7800 m^2 and antenna efficiency of 0.4, what is the peak power (in Watts)?

17. If the first amplifier in a receiver has a noise temperature of 4 K and gain of 30 dB (i.e., gain = $10\times\log(P_{out}/P_{in})$ = 1000), and it is followed by a mixer with a noise temperature of 1000 K, what is the contribution of the mixer to the system noise temperature?

18. What is an adequate amount of scans and number of samples in each scan, to map the solar disk at 87 GHz using a 20-m diameter radio telescope? If the antenna can be moved at a speed of 1 arc min/second (on the sky), how long does it take to make a full disk map of the Sun?

19. A radio dynamic spectrum shows a frequency-drifting type III burst. The emission is observed to drift from 300 MHz at 10:05:55 UT to 70 MHz at 10:05:58 UT. Give an estimate of the burst source speed.

20. A solar flare was observed at many radio observatories which were recording the radio flux density at different frequencies: Metsähovi at 37 GHz, Tuorla at 22 GHz, San Vito at 15 GHz, Zurich at 11 and 5 GHz, and Ondrejov at 2 GHz. At two different times the observed fluxes were:

at 10:15 UT:	at 10:30 UT:
2 GHz – 150 sfu	2 GHz – 12 sfu
5 GHz – 35 sfu	5 GHz – 25 sfu
11 GHz – 180 sfu	11 GHz – 85 sfu
15 GHz – 175 sfu	15 GHz – 100 sfu
22 GHz – 80 sfu	22 GHz – 105 sfu
37 GHz – 30 sfu	37 GHz – 102 sfu

a) Calculate the spectral index (indexes/indices) at both times and deduce the possible emission mechanisms
b) What things should you consider when analysing radio flux density spectra that consists of data coming from different observatories?