53 (EC 810) RENS

2013

(May)

RADAR AND ELECTRONIC NAVIGATION SYSTEMS

Paper : EC 810

Full Marks : 100

Pass Marks : 30

Time : Three hours

The figures in the margin indicate full marks for the questions.

Answer ***any five*** *questions*

1. *a)* What is meant by unambiguous range in Radar ? Show that the unambiguous range is given by $Ru = C\tau/2$; where 'τ' is the delay in pulse transmission. 4+6

   b) Show that two targets located at ranges 'R_1' and 'R_2' can be resolved exactly if the range resolution is given by $\Delta R|_{min} = c/2B$; where 'B' is the bandwidth of the radar. 6

c) Consider a radar system with unambiguous range of 100 *km* and a bandwidth of 0.5*MHz*. Compute *(i)* pulse repetition frequency *(prf) (ii)* pulse width (τ).

2+2

2. a) Discuss the operation of Pulse-Doppler radar.

b) Show that for CW Doppler radar; the output from the mixer/detector is given by $\frac{A}{2}\cos\left[\frac{4\pi}{\lambda}\frac{dR}{dt}\right]$; where the symbols have their usual meaning.

c) Prove that the Doppler frequency for a target moving with a radial velocity '*dR/dt*' is given by $fd = \pm\frac{2(dR/dt)}{\lambda}$; where '$\lambda$' is the wavelength of radar signal.

8+6+6

3. a) Deduce the radar range equation given by $Rmax = \left[\frac{P_T.G.\sigma.Ae}{(4\pi)^2 Smin}\right]^{1/4}$; where the symbols have their usual meaning.

b) A certain rader has a bandwidth of 0.4*MHz* and the average time between false alarm is 30 *min*. What is the probability of false alarm and the threshold-to-noise power ratio $\left(V_T^2/\psi_0\right)$?

c) Show that a single-delay line is equivalent to a high-pass filter. How the delay can be achieved in a radar-based system ?

8+4+8

4. a) Describe the operation of a MTI-based radar.

b) Deduce the frequency response of single-delay line canceler in connection with MTI-radar. What is blind speed ?

c) What methods are available for reducing the detrimental effects of blind speed ?

8+7+5

5. a) What is Rayleigh criterion for smooth surface?

b) Show that the effect of multipath propagation on radar range equation is to change the return power dependance on range to R^{-8} rather than R^{-4} relationship found in free space. 4+16

6. *a)* What is an analytic radar signal ? How does it differ from a real radar signal ?

b) Find the response of an analytical network fed by an analytical input.

c) Compute the maximum instantaneous SNR at the output of a linear filter whose impulse response is matched to the signal $x(t) = e^{-(t^2/2T)}$. 5+10+5

7. Write short notes on ***any two*** of the following : 10+10

i) Matched filter SNR.

ii) Single-pulse radar ambiguity function.

iii) Delay estimation using single envelope of a radar-pulse.
